EDITORIAL

HAVE you saved any money to invest in the Second Liberty Loan?

A 200-ton concrete ship was recently completed in Norway. The work was finished in three weeks.

ENGINEERS of the Bay cities should be careful to make no engagements that might interfere with their attendance at the joint meeting of the San Francisco sections of the five national engineering societies on the evening of October 25 to greet Mr. Ira N. Hollis, president of the American Society of Mechanical Engineers.

IN preparing the manuscript of Mr. Carl F. Adam's article on 'Overhead Costs on Paving Contracts in Los Angeles' for publication in our September number, a note stating that the 'Engineer's Bill' includes the cost of advertising, printing, engineering, and inspection was inadvertently omitted. Readers should note the correction.

RUSSIAN affairs are engaging a good deal of the attention of most of us. In recognition of this fact, and of the need for really authentic information, a Russian information bureau, with headquarters in the Woolworth building, New York, has been established with the co-operation of the American-Russian Chamber of Commerce. Bulletins will be issued dealing with events affecting the political, economic, and social situation in Russia.

WOMEN are taking the places left vacant by men who have been called to the colors. As far as engineering work is concerned, this has been confined hitherto to relatively unimportant positions in the drafting office and computing room. Recently, however, Miss Esther Jack has been appointed city engineer of Williston, North Dakota, succeeding Captain E. R. Evans, who has been called to the Federal service. Miss Jack was the first woman to graduate in civil engineering from the State University of North Dakota.

WHILE the cost of almost every commodity has increased considerably during the past few years, the average cost of transporting freight by rail in 1916 was the lowest on record. In 1891, the first year for which the Interstate Commerce Commission has records, the average cost was 8.95 mills per ton-mile. This decreased until 1899, when the average rate was 7.24 mills, and then increased to 7.80 mills in 1904. Since then the curve has fluctuated slightly, but with a generally downward trend, until in 1916, the rate was 7.16 mills.

DELAY in announcement of Federal civil service examinations is discussed in another column by a prominent Western engineer. Much the same criticism might be made regarding the notices of examinations appearing in our own columns, while in the case of many positions, too little time is allowed to make an announcement in a monthly publication of any value whatever. It is unfortunate that some of the Federal officials in this as in other departments, while having the best of intentions, have not yet realized how large this country is. We agree with our correspondent that the best engineers are not hanging around the bulletin-boards.

CAR-SHORTAGE, or as the railroads prefer to call it, excess of unfilled car-orders, continued to decrease during August, the amount being 31,000 at the end of the month as against 34,000 at the beginning. Since transportation of troops to the training camps began in September as well as an increased crop-movement, it is hardly to be hoped that this reduction will continue, but the excellent showing made during the spring and summer makes it probable that serious congestion will be averted. Some idea of the wonderful achievements of Railroads' War Board may be gained from the statement that the increase of freight traffic on American railroads during the past two years is equal to the total freight traffic of Great Britain, France, Russia, Germany, and Austria combined.

ONE important way to help conserve supplies and win the War is to cease demanding unnecessary refinements in quality of materials. This is particularly true in the case of petroleum products. In the early days of the industry, unskilful refiners frequently produced yellowish gasolines and kerosenes that happened also to be objectionable for other reasons, and in some cases dangerous. Gradually the public came to demand that gasoline must be 'water-white', although it is well known that this property is by no means essential. It is probable that nothing has hindered the development of cracking processes so much as this prejudice against gasoline that has the slightest yellowish tinge. Another handicap that this prejudice has imposed on the industry has been the burden placed on refiners of treating gasoline with sulphuric acid and caustic soda. All that this treatment does is to remove the unsaturated hydrocarbons from the gasoline, and it is known that these have a greater fuel-value than the saturated hydrocarbons. An article in 'Oildom' estimates that the loss in the United States amounts to 30,000,000 gallons of gasoline, 35,000 tons of sulphuric acid, and 3500 tons of caustic soda, a total loss of $10,000,000 a year.

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The Butte County Hall of Records Referendum

After more than two years of litigation, the question of the legality of the proposed referendum election regarding the construction of the Butte County Hall of Records has been decided. The case is of such far-reaching importance in its effect upon public work throughout California, that a brief review will be of interest.

In 1915, the need of a separate fire-proof building for use as a Hall of Records became apparent to the Board of Supervisors of Butte county, and a resolution was passed and a call for bids issued. The bids were opened and the contract awarded to a San Francisco firm. Meanwhile, a referendum petition had been circulated, and was presented with the proper number of signatures to the Board of Supervisors. The Board, however, refused to call an election, claiming that the referendum did not apply in this particular case.

The case was tried first before Superior Judge O'Donnell of Solano county, who, in September 1915, ruled that a writ of mandate should be issued compelling a call for an election. A year later, the Appelate Court reversed this decision. The case was then carried to the State Supreme Court, which has just reversed the decision of the Appelate Court, and ordered that an election be held. It is probable that the matter will be dropped and the construction of the building abandoned. The contractors have long since been released from their agreement.

Whether or not the decision of the Supreme Court is good law is outside our province, but the effect of the decision upon public work in California is a matter of grave concern to engineers and contractors. Apparently the decision holds that the right of referendum applies to any act of the officers of a political unit. A Californian contractor must now be enough of a politician to determine, before bidding on public work, whether or not public sentiment is such that a referendum petition is likely to be filed, and no contractor will dare to commence on such work until the legal time for presenting such petitions has expired. In fact it might be said that this decision makes all classes of public work as objectionable from the contractor's standpoint as certain provisions of the Vrooman Act make street improvement. It is hardly necessary to show that the decision is just as bad for the interests of the general public as it is for those of the contractor. Increased uncertainty regarding payment, etc., will result in higher bidding prices, while the delay occasioned by waiting to see if anyone wants to start a referendum, may in certain cases be even more objectionable than the increased prices. If, as seems probable, the wording of the law is such that the courts can afford no relief, it will be necessary for the legislature to take such action that public work be not delayed and reasonable bidding-prices on such construction may be obtained.

More Rules for Saving Freight-Cars

The man who loads his cars to full capacity and then imagines that he has done his full war-time duty will find how mistaken he has been when he has read the following rules. They were prepared by W. C. Lindsay, traffic secretary for the National Confectioners' Association, but apply equally to other shippers of freight:

1. Anticipate wants and order supplies far enough ahead to allow the railroads plenty of time for transportation. Keep a fair supply of raw materials always on hand.

2. Impress upon customers to do likewise. A circular to them along these lines will do considerable good.

3. Ship freight promptly by the most direct route and allow the carriers plenty of time to get shipments to or from destinations.

4. Do not trace shipments unless it is necessary. Too much tracing is a burden to the railroads and keeps their clerks from other important duties.

5. In purchasing in carload lots, if possible do not buy minimum carloads, but have cars loaded to the maximum capacity—plus 10% in excess of marked capacity of cars if possible. This means that one car does the work of two and relieves the railroads just that much.

6. Load cars promptly when placed and furnish shipping instructions without delay.

7. Prompt orders should be given for disposition of cars after arrival at destination. Where possible, disposition-orders should be placed with carriers' agent in advance of arrival, thus avoiding unnecessary switching.

8. Pack goods in strong containers. This will not only satisfy the railroads but customers as well.

9. Mark packages plainly and prevent shipments going astray, which is almost equal to waste.

10. Be sure that bill of lading shows the same destination and consignee as the marks on the package. If the package is marked one way and the bill of lading another, shipments will be delayed.

11. Have shipments delivered to the railroad depots not later than 4 o'clock, so the railroads will have time to load and forward the same day.

12. Unload cars promptly, taking no advantage of free-time allowance, having in mind the return of cars to active service.

13. Endeavor to obtain heavier and more systematic loading of so-called trap-cars.

14. Induce customers to increase orders that usually move in less-than-carload quantities to an amount requiring a full car, anticipating future orders, thereby securing better service and at the same time relieve the unusual conditions now prevailing at freight-stations and transfer-terminals.

15. Where possible, a less-than-carload shipment should be held to accumulate to one of larger size, thereby assisting the carriers to load package-freight to heavier capacity and making it easier to regulate the movement of merchandise-cars, distribute freight, and arrange schedules to better advantage.

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REVIEW OF THE MONTH

IRON AND STEEL prices have been fixed as a result of an agreement between the manufacturers and the War Industries Board. The prices per ton at Pittsburgh and Chicago for the principal grades are as follows: Pig iron, $33; steel bars, $58; steel plates, $65; steel shapes, $60. This is a reduction of about 50% on most of the grades, although since freight is such an important item on costs on the Pacific Coast, the proportionate reduction here will not be so great. These prices will hold until January 1, 1918, and will then be revised if experience has shown them to be inequitable.

NAVIGATION on the Sacramento river is the subject of a preliminary report by Major L. H. Rand of the United States Engineer Office. A detailed investigation of the entire situation is to be made, and public hearings will be held at which interested parties may express their ideas. The present plans of the Army Engineers is for a seven-foot mimimum depth as far as Sacramento, a four-foot depth between Sacramento and Colusa, and three feet from Colusa to Chico Landing. While the report necessarily makes no definite recommendations, it indicates that a nine-foot depth to Sacramento, and a six-foot depth to Colusa with a diminished draft for a short distance above that point is desirable, and that the expense of maintaining conditions permitting low-water navigation above Colusa is not justified.

THE authority of Congress to dispose of the public domain in practically any way that it sees fit was sustained by the Supreme Court of California recently in the case of the City of Los Angeles *v.* the Silver Lake Power & Irrigation Company. Some time before the construction of the Los Angeles aqueduct, the Silver Lake company spent several thousand dollars in the Owens River valley on an irrigation and power scheme. This work was interrupted by Federal withdrawals of a large amount of land in that vicinity in connection with a proposed reclamation project. This project was later abandoned. In the meantime the aqueduct had been started. The company resumed work on its project and in April 1915, a suit was brought regarding the water-rights, the city claiming that these were essential to its water supply. The Court now holds that the United States can by withdrawal-orders arrest work on irrigation and power projects on Government land, without compensation to the locators, and that the vacation of such withdrawals does not operate to revive the rights of locators. The case of the withdrawn oil-lands is cited in support. This decision is doubtless in accord with the letter of the law, but it makes the investment of money in power-projects on Government land even more of a gamble than it was before. This is against the interests of real conservation and does not help to win the War.

ACCIDENTS at grade-crossings, like the poor, are likely to be always with us. The elimination of grade-crossings when financially practicable, will help considerably in reducing the number of accidents, as will also a general campaign of education in 'Safety First' among motorists. Probably the discontinuance of the manufacture of distilled liquors will also contribute toward the desired end. Nevertheless, accidents at a particular type of crossing, namely, where the railroad grade is considerably above the highway, are not always the result of carelessness on the part of the motorist. There is great danger of the engine 'going dead' on the track, either as a result of changing gears, or of an attempt to go over the crossing on the high gear and still at a low enough speed to avoid jolting when crossing the tracks. Before the car can be started again the locomotive may strike it and a serious accident occur. To prevent this type of accident, the 'Concrete Highway Magazine' suggests making the highway level for at least 30 feet on each side of the railroad tracks, even if this requires a steeper grade at the end of each level stretch than there was originally at the crossing. Since for a 16-foot roadbed this would require only about 40 cubic yards of embankment per foot of vertical fill the cost would be comparatively small. This kind of crossing could well be constructed at a number of places where separation of grades will be financially impracticable for many years to come. Another advantage of such a crossing is that since it affords a clear sight for at least 60 feet at the crossing, it would tend to prevent collisions between automobiles coming from opposite directions.

THE complete report of the Committee on Petroleum of the California State Council of Defense has just been issued. The main report comprises the best treatise on every part of the Californian oil industry that has ever been printed. The final chapter contains the committee's recommendations regarding means of preventing the threatened serious shortage of petroleum products, an abstract of which appeared in a recent issue of WESTERN ENGINEERING. Events since the recommendations first appeared have emphasized the importance of the committee's recommendations. While the completion of two particularly good wells, one in the Midway-Sunset and one in the Whittier-Fullerton field, resulted in some increase in the production of the State during August, shipments were considerably

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higher than in July, and the shortage for August was greater than for July. It is probable that this difference in shipments for the two months was largely a matter of chance, and the actual consumption was nearly constant.

TAKING up the main recommendations of the committee in detail, economic necessity is probably more effective in forcing economy in the use of petroleum products, and the substitution of other fuel or power where feasible than any law that could be enacted. The extent of exemption of oilfield workmen from the draft seems to depend mainly on the definition of the term 'skilled workman.' There was very little hesitation about exempting drillers, the majority of whom are above the draft-age anyway, but the selection boards seem to have been reluctant to exempt any other class of workers. Whether the oil companies can replace these other workers and maintain the general efficiency of their establishments remains to be seen. With regard to supplies, so far no steps have been taken by Federal authorities toward preferential treatment for oil-operators, but this is not surprising in view of the many other important problems that have engaged their attention. The principal recommendation of the committee along the line of increased production, namely, opening to development at least part of the land now in litigation seems to be as far away as ever. The leasing bill, which seemed a short time ago to have a good chance of both consideration and passage, appears now to be crowded out, and there is little chance of any action being taken at this session.

A WAR COMMITTEE of Technical Societies has been organized by the Engineering Council. The function of the committee will be to act as intermediary in matters relating to science, research, invention, and engineering between the Army, Navy, and various other Governmental agencies and semi-official committees, and the main membership of the societies represented. The American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, Mining and Metallurgical Society of America, American Electro-Chemical Society, and American Institute of Electrical Engineers have appointed representatives on this committee. By the time this reaches our readers it is probable that the American Chemical Society and the Society of Automotive Engineers will have taken similar action. In another column appears a discussion of 'The Submarine Problem,' prepared by the Naval Consulting Board, which the committee has mailed to the members of the various societies.

ACQUIREMENT of the United Railroads properties by the city of San Francisco is once more under discussion. For some time the company has been anxious to sell and the city anxious to buy, but the fact that the city is already near its bonding-limit has interfered with naming even tentative terms. The latest suggestion is that the city shall take over the company's property without any cash payment. The city is to pay the company the appraised value of the property, payment being distributed over a term of years. The franchise question is to be settled by an annual payment to the company equal to the present net operating income for a normal year. These payments are to continue for 14 years, this being the average remaining life of the company's franchises. It remains to be seen whether these terms will be satisfactory to the city and the company. It is stated, with what foundation we do not know, that the net earnings will be sufficient to make the required payments.

AMONG the "economies" suggested will be the elimination of State taxes, reduction of overhead charges, and stopping of duplication of service. The first is a real and unfair advantage that municipally-owned utilities have at the present time in competition with private companies. Elimination of litigation between the two systems would undoubtedly result in some reduction of overhead charges, but it is probable that any other reduction would be simply a bookkeeping transfer of the burden, placing it upon the taxpayer instead of the street-car patron. Stopping duplication of service to any considerable extent could be accomplished only by stopping or reducing service on some of the unprofitable lines. If the new municipal system could be kept out of politics, this could be done; otherwise it could not. It is probable, and is in fact hinted in the proposed agreement, that if the city takes over the company's system, jitney competition will be eliminated by ordinance. This would, of course, result in a considerable increase in street-car revenue. Whatever the specific terms, however, almost any consolidation would be preferable to the present dual system.

A war-measure of doubtful expediency was recently adopted at Portland, Oregon. Eight years ago a district was established in the main business part of the city in which new buildings were required to be fireproof. Owners of vacant lots and of old buildings in this district have found it difficult to raise the money needed to construct buildings complying with the ordinance, and the increased cost of building-materials has aggravated this condition. In the face of considerable opposition a new ordinance has been passed, permitting the erection of mill-construction buildings within the fire-limits. Such buildings are to have brick, concrete, terra cotta, or stone exterior walls. Each floor is to be equipped with an automatic sprinkling-system, and the height of the buildings is limited to four stories. While it is true that such buildings are almost as fire-resisting as the so-called fireproof structures, the decision is nevertheless, a step backward. In particular, there is evident injustice to the owners who have been compelled by the previous law to construct fireproof buildings, and who will now have structures that are not so fire-resisting erected in their vicinity.

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DISCUSSION

Delay in Announcements of Civil Service Examinations

The Editor:

Sir—The following is a copy of a letter which I have addressed to the U. S. Civil Service Commission:

United States Civil Service Commission,
Washington, D. C.

Gentlemen:

I wish to call your attention to an injustice to which the Commission has, perhaps unintentionally, subjected Western engineers in the matter of notifications of examinations. My attention has been called to this before but a recent instance will illustrate:

In the August 23rd issue of the 'Engineering News-Record' are three notifications of examinations. Two were scheduled for September 5 and one for September 4. Now it is impossible for a notice mailed from New York on the 23rd to reach the Pacific Coast and return to Washington in the time given. To get the necessary papers, fill them out, and return them to Washington would require a week or ten days more than is allowed by the notice. You see therefore that these notices were of value only to engineers in the East, and that these men were given an advantage that was denied a large number of competent Western men.

I am aware that the Commission assumes no responsibility for the lack of sufficient notices and that engineers and others who might be interested in coming examinations can post themselves by watching the notices in the various Federal buildings. I think though that the men that the Commission wants are not watching these posting-boards. To get the best class of men on the registers the technical papers should be used but unless sufficient time is given to all to present the proper papers in Washington the Commission is acting unfairly to a large body of Western engineers.

KENNETH A. HERON.

Lakeview, Oregon, September 12.

Why the Railroads Should Foster Highway Construction

The Editor:

Sir—The railroads have been and are one of the greatest factors in the development of the natural resources of America. Railroad building and the development of the surrounding country have gone hand in hand. One cannot get along without the other. Railroad builders have been quick to appreciate this, and have not merely constructed railroads, but have done everything possible to foster the growth of the country traversed and to make conditions better and more attractive for the settler. By so doing they have built up feeders for their lines and by accelerating the growth of the different communities a proportionate acceleration of the growth of annual profits is made possible.

All this is good policy. While particular instances could be noted where the railroad companies have done the opposite of assisting struggling communities, still it must be admitted that they have as a rule been active factors in the growth of the country.

During the past ten years we have seen the development of motor-truck transportation, which bids fair to be an active rival of the railroad for both freight and passenger business. The railroad-owner must face this situation fairly and squarely and find a solution for the problem. The temptation to attempt to legislate the motor truck into oblivion is strong, but it should be remembered that public sentiment is in favor of the motor-bus and truck, and what the people want they will have in the end. The legislative solution is therefore only temporary. It seems, however, possible that the far-sighted railroad official can turn this motor traffic to his advantage and in place of a competitor, obtain a feeder and a source of income.

How can this be done?

By the railroads fostering a system of properly constructed highways, highways constructed on modern scientific principles and capable of 'standing up' under heavy truck and bus traffic. If the railroads can accomplish the construction of these feeder highways, thus enlarging the area tributary to their own lines, and then handle the traffic properly when it reaches their lines the need and desire for the construction of parallel highways, competing with the railroads will be largely obviated.

With regard to ways and means of aiding in the building of highways to the best advantage, both to the railroad and to the community at large, I would suggest that the railroads appropriate sums sufficient for investigations by their engineering departments, if possible with the co-operation of local highway engineers, as to the most feasible system of feeders to be developed in each district. The engineering departments should report as to the position and probable cost of these highways and estimate the probable traffic, both passenger and freight, which might be expected when such roads are completed and in operation. The special advantages of each particular road, both to the public and to the railroad, can be outlined, and when such reports are completed and all necessary information at hand, the

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matter should be referred to the county authorities and all information placed at their disposal. A good publicity man would be needed in each district to arouse public sentiment in favor of highways.

Let us not lose sight of the vital question as to who is going to pay for these highways. It is true that the people of the different communities should bear the largest share of the expense, but there is no reason why the railroad should not assist materially.

To build highways requires money. The contractor must be paid, in cash if possible, thereby saving discounts on bonds, which must be charged against the work. This cash is usually raised by the sale of bonds. These bear interest at rates up to 7%, but can seldom be sold at par. It seems almost certain that the railroad official, with his finger on the pulse of the bond market, and his many connections in the world of finance, could secure better prices for such highway bonds than is now the rule. It might frequently be good business for a railroad company to purchase the bonds at a premium and charge the loss to advertising.

Undoubtedly there are many ways in which the railroad can secure these feeder highways. Once the railroad official makes up his mind that such highways are necessary to his business, it will follow that his publicity organization, his engineering organization, and his financial organization will surely be exerted to their capacity and will accomplish, as they always have, whatever they set out to do.

It behooves the railroad official to help the communities to better highways or they will help themselves and the railroads will find that their usefulness has been outgrown.

FRED H. CHESNUT.

Burlingame, September 14.

COMBATTING ICE-CONDITIONS IN POWER-PLANT OPERATION*

The successful operation of a hydro-electric plant in a severe climate depends in a large measure on the method of providing for or eliminating ice-troubles. Of the three principal kinds, sheet-ice is the least detrimental to operation; in fact if sheet-ice were the only kind to be handled, the trouble would be negligible. Where the channels are small, however, and where anchor and frazil have been formed above, trouble may be experienced, because of the lodging of this frazil and loosened anchor-ice, under the sheet-ice. Frazil-ice, in the presence of sheet-ice, attaches itself to the under side of the latter. Where the channels are small, the whole flow of the stream may become blocked. Overflow will then occur and much of the stream-flow will be lost.

One of the best methods, however, of avoiding frazil and anchor-ice troubles is to obtain a pond, in the immediate vicinity and above the intake of the plant, of sufficient size and depth so that it will readily freeze over; the ice-sheet obtained will, to a great extent, eliminate any troubles with frazil or anchor-ice.

If the entrance to the power-plant is a restricted channel, the ice-sheet will be a hindrance rather than a benefit, provided there is open water above. In such a case it is better to be without a sheet of ice, and instead make provision for handling the accumulation of frazil and anchor-ice at the head-works. There have been many attempts made to deal with this problem, but it generally degenerates into a brute-force combat. In many plants, provision is made for passing masses of frazil-ice through the wheels by raising the racks in sections. Currents are then induced to pass across the face of the racks, so that the floating ice, etc., may be carried away.

The great trouble with frazil-ice is its freezing on the racks and the wheels, finally stopping the supply of water. With regard to the racks, this has been usually because the upper ends of the bars composing them have been left protruding above the water for 2 or 3 ft., thus exposed to the cold air. Iu such a position these bars become chilled to the bottom. Even when only cooled 0.003° below freezing-point, it is sufficient to cause the frazil-ice to adhere to the bars and commence the clogging process. This trouble may be eliminated to a great extent by making the upper part of the rack of wood, and keeping the metal bars entirely submerged, thus preventing the conduction of heat from the bars to the atmosphere, and the consequent cooling below freezing-point. Besides this method of submerging the metal of the racks, schemes have been brought forward for heating them, such as using hollow bars through which steam may be driven. In many plants the head-works are housed and heated, not only to provide a good working-room for the men fighting the ice, but also to prevent the cooling of the racks. One of the most successful schemes has been that employed by one of the plants in Ottawa. There the tops of the bars are encased with sheeting, the steam-pipes being also enclosed. By this means ice-troubles have been prevented to a great extent. The use of a live-steam jet in the wheel-case and guide-vanes to prevent freezing or clogging at the wheel-entrance has been successful in several plants.

*From report of Dominion Water-Power Branch, Department of the Interior, Ottawa, Canada.

Trackless trolleys are in use at Bradford, England. The first line was established in 1911, and there are now five routes, the total length being 9½ miles. Power is supplied from an overhead wire, and the vehicle runs along the street on solid rubber tires. The first cost is about one-tenth that of an ordinary rail system. Such a system requires a smooth roadway, and there is considerable wear on the pavement, but good results have been obtained with both concrete and macadam pavement. Each car has a seating capacity of 29. The average operating cost including interest and sinking-fund charges is $0.155 per car-mile.

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Cross-State Laterals for California Highway System

The State Highways Act of 1915, which was ratified by the voters in November 1916, provided for a bond issue of $15,000,000, of which $12,000,000 is to be used for completing the original system provided under the State Highway Act of 1909, and the remaining $3,000,000 is to be used in co-operation with the several counties for the construction of various lateral highways. Preliminary surveys have been made of these laterals and the following information has been obtained:

The proposed lateral from Weaverville to Eureka by way of the Trinity river will be 98 miles long, 48 miles of which will be in Trinity county and 50 miles in Humboldt county. The country traversed is mountainous and there are no existing roads for a large part of the distance. This highway, when completed together with the Redding-Weaverville lateral to be built at a part of the original highway system, will provide a connection between the main Coast highway at Eureka and the Valley highway at Redding. The total distance from Eureka to Redding will be about 148 miles. The highway will aid in the development of a considerable area of mining and timber country.

The lateral from Gilroy on the Coast highway by way of the Pacheco pass to Califa on the Valley highway will be 83.4 miles long, 26 miles of which will be in Santa Clara county, 41.7 miles in Merced county, and 15.7 miles in Madera county. About 45 miles of this will be in the Santa Clara and San Joaquin valleys, and the remainder the rolling foothills and in the Mt. Diablo range of mountains. There are existing unimproved roads along the entire route, but a number of changes will be required to reduce grades and curvature. Besides providing a connection between the two main highways, this road will assist in the development of the agricultural and stock-raising country through which it passes.

The third highway runs from Mariposa to El Portal, at the gateway of Yosemite valley, 32.6 miles, all in Maripsoa county. A large part of the distance will be across country where there are no existing roads. While the country traversed has some mining, timber, and grazing resources, the principal value of the highway will be to make the Yosemite valley and the sorrounding 'vacation' country more accessible.

The fourth highway proposed runs from Hanford by way of Coalinga to San Lucas on the main Coast highway. Ten miles will have to be constructed in Kings county, 48 miles in Fresno county, and 28.3 miles in Monterey county. Between Hanford and Coalinga the highway is practically parallel to the Southern Pacific railroad. Between Coalinga and San Lucas the country is sparsely settled, but has agricultural and grazing resources whose development would be assisted by the proposed highway. There are existing roads along most of the proposed route, but a number of changes in grade and alignment will be necessary.

The fifth highway runs from Famosa on the Valley highway by way of Wasco and Lost Hills to Paso Robles on the Coast highway. The mountains are crossed at Polonio pass, which the U. S. Geological Survey takes as dividing the Mt. Diablo spur of the Coast Range mountains from the Temblor spur. The elevation at this point is only 1800 ft. Deducting the concrete-paved highway between Wasco and Lost Hills, constructed as part of the Kern County highway system, there remains 72.2 miles to be built, 33 miles in San Luis Obispo county, and 39.2 miles in Kern county. There are existing roads along the proposed route, but a number of changes will be needed on account of grades and curvature. Besides furnishing a connection between the two main highways, the road will make a considerable agricultural and grazing area more accessible. The Lost Hills oilfield, and several less important oil districts, none of which have railroad facilities, are on or near the proposed highway.

The sixth highway runs from San Bernardino to Barstow, 76.3 miles, all in San Bernardino county. This road will cross the Cajon pass at an elevation of 3800 ft. A number of changes will be required in the existing roads on account of grades and curvature. While some land is being irrigated along the line of the proposed road, the principal industry is mining. This road will practically parallel the existing main line of the Atchison, Topeka & Santa Fe railroad.

The seventh highway named in the Act was one connecting Antelope valley with the city of Los Angeles. Los Angeles county is now building a highway by way of Mint Canyon, which the State is to take over, so that this highway has been provided.

The last lateral proposed runs from San Bernardino by way of Brawley and El Centro to Yuma, 220 miles, approximately 25 miles in San Bernardino county, 75 miles in Riverside county, and 120 miles in Imperial county. This road will parallel existing railroads for practically the entire distance, but the present highways are most of them poor, although the country is none of it mountainous.

The approximate length of all the proposed roads is 670 miles, and the total estimated cost, based on the rough preliminary surveys that have been made, is $7,750,000. Of this amount, as has already been stated, $3,000,000 is available from the State bond issue. If the roads are to be built, the remaining $4,750,000 must be obtained from the counties and from the Federal government. The Federal Aid Road Act provides for the expenditure in California of approximately $450,000 during the year ending June 30, 1919, and $600,000 and $750,000 during the two succeeding years. In addition,

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$140,000 is appropriated each year for the construction of highways and trails for the development of the National Forests. These highways need not necessarily be within the National Forest boundaries, provided they help to make them more accessible. Of the highways proposed, somewhat over one-half the Weaverville-Eureka road lies within the Trinity National Forest, and nearly all of the Yosemite Park road is in the Stanislaus National Forest.

It is impossible to tell what part of these Federal funds can be obtained for the construction of these particular highways. It should be remembered, however, that there are a number of other proposed highways, including, for instance, the laterals of the original highway system that run to the mountain county-seats, that are likely to be considered in apportioning the Federal funds. It therefore seems probable that the counties will have to do more than simply share expenditures with the State on a '50-50' basis.

An idea of the situation of the counties as regards the proposed expenditure can be gathered from the following summary. The population is for 1910 and the valuation and expenditures are for the fiscal year ended June 30, 1916. The expenditures include bridges as well as highways:

County	Highway mileage	Population	Assessed valuation	Highway expenditures
Trinity	48.0	3,301	$3,208,420	$ 24,307
Humboldt	50.0	33,857	31,709,835	328,959
Santa Clara	26.0	83,539	78,269,470	528,571
Merced	41.7	15,148	23,134,890	142,276
Madera	15.7	8,368	14,128,507	60,010
Mariposa	32.6	3,956	3,384,438	16,830
Monterey	28.3	24,146	31,131,859	459,294
Fresno	48.0	75,657	85,651,020	445,948
Kings	10.0	16,230	15,685,160	208,774
San Luis Obispo	33.0	19,383	19,254,442	72,499
Kern	39.2	37,715	75,352,435	1,364,168
Riverside	75.0	34,696	29,124,593	802,851
Imperial	120.0	13,591	26,127,207	176,854
San Bernardino	101.0	56,706	43,673,365	1,547,681

Of these counties, Kern, Kings, Monterey, Riverside, and San Bernardino have voted bond issues for highway construction of $2,500,000, $672,500, $570,000, $1,500,000, and $1,750,000 respectively, and some, at least, of the bond money is included in the above figures. The highway systems of Monterey, Riverside, and San Bernardino counties have since been completed, while those of Kings and Kern counties are still under construction. In Kings county a special tax of about $200,000 has been proposed in order to complete the system planned under the bond issue.

Convict labor was employed in San Bernardino county, California, for the construction of the Lytle Creek road. The road was 3.4 miles long and cost $15,482.85, or $4553.82 per mile. The cost of earth excavation was $0.22 per cu. yd. and of rock excavation, $0.63 per cu. yd., whereas the estimated cost, based on contract prices on similar work, was $0.30 and $0.85, respectively.

FINANCIAL STATISTICS OF CALIFORNIAN COUNTIES AND MUNICIPALITIES

The following statistics were compiled by the Taxpayers Association of California for the 57 counties in California, exclusive of San Francisco, for the year ended June 30, 1916:

TABLE I

RECEIPTS OF CALIFORNIAN COUNTIES

Source	Percentage of total
General taxes	44.45
Licenses and permits	0.33
Fines and penalties	0.41
Privileges	0.09
Rents	0.14
Interest receipts	0.81
Subventions and grants	11.36
Gifts, donations, etc.	0.35
Fees	1.94
Special services rendered	0.19
Sale of real property	0.06
Miscellaneous	1.20
Trust funds and accounts	1.84
Correction of errors	0.29
Cancelled warrants	0.01
Agency transactions:	
For State	4.31
For districts	29.64
For municipalities	2.58

The average receipts per capita were $27.89.

TABLE II

EXPENDITURE OF CALIFORNIAN COUNTIES

Source	Percentage of total
General government	10.11
Protection to person and property	3.81
Conservation of health	0.13
Sanitation and cleanliness	0.04
Highways, bridges, etc.	21.57
Charities and corrections	5.77
Education	38.67
Recreation	0.24
Miscellaneous	1.36
Trust funds	1.18
Payment of interest	3.49
Redemption of debt	2.60
Correction of errors	0.12
Agency transactions:	
For the State	4.37
For districts	4.27
For municipalities	2.18

Expenditure per capita for police and fire-protection in cities are also given, as follows:

Population of city	Police department Highest	Police department Lowest	Fire department Highest	Fire department Lowest
Under 1000	$4.75	$0.15	$2.80	$0.02
1,000 to 2,500	2.16	0.10	1.45	0.03
2,500 to 5,000	2.01	0.09	3.12	0.03
5,000 to 7,500	1.85	0.16	2.19	0.05
7,500 to 10,000	2.35	0.56	1.36	0.35
10,000 to 15,000	1.60	0.45	1.12	0.31
15,000 to 20,000	1.55	0.68	1.53	0.37
Over 20,000	3.20	1.43	3.15	1.54

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The Submarine and Kindred Problems*

Electro-Magnets and Magnetism

The electro-magnet, the magnetic needle, permanent magnets, and magnetism have been carefully studied for many years; and the laws governing their application may be found in any book on the subject.

Although these laws are generally known, and applied in a practical manner, in a multitude of devices in common use, even the man of wide experience will be astonished at the limited range of practical effect of electro-magnets of large size. For instance, the magnets used in our manufacturing-plants for lifting heavy masses of iron or steel are designed to exercise maximum magnetic effect, and for operation require a considerable amount of electrical energy; yet a magnet which can lift 20 tons, when placed in contact with an iron plate of that weight, will not lift a 2-in. cube of iron or steel if separated from it a distance of 2 ft. Therefore proposed devices which depend on the attractive power of magnets for their operation in deflecting or arresting torpedoes, mines, or submarines, must be governed by the simple laws of magnetism. A torpedo weighing approximately 2500 lb. and traveling at a speed of 25 to 45 miles per hour, will not be deflected to any practical degree by any known application of magnetism. It is not believed that an enemy torpedo, mine, or submarine will ever be found in a position to be hindered effectively by any electro-magnetic means, however powerful.

Electrical Effects in General

There is a general misconception regarding the 'electrification' of water and the atmosphere. There is no known method of 'charging the sea with electricity,' or 'shooting a bomb of electricity,' or of 'charging the atmosphere with electrocuting current.' Suggestions along these lines should show that the writer has made research in the laws governing the application of electrical energy and should contain sufficient proof of their feasibility to insure serious consideration.

On the other hand, applications of the transmission of electrical energy by means of alternating or pulsating currents—as used in wireless systems, for example—belong to a different class of electrical development. Inventive genius is rapidly improving apparatus of this type for the sending and receiving of signals and messages, and the possibility of valuable results in this field is unlimited.

Protection Against Submarine Attack

This subject which is occupying the public mind as is no other, divides itself into a number of problems, the most important being the following:

1. Means of discovering the approach of a hostile submarine and ascertaining its position so as to permit of prompt action for combating its attack.
2. Protection of cargo-carrying ships by nets, guards, and screens.
3. Protection through decreasing the visibility of vessels.
4. Methods of destroying or blinding a hostile submarine.

Submarines, to operate most effectively, must approach within close range of the vessel that is intended to be torpedoed. The installation of offensive weapons on the merchant marine has increased the necessity for the utmost care being exercised by the submarine-commander in remaining unseen by the officers on the vessel to be attacked.

Reports from abroad indicate that in many cases submarines must have remained along certain lanes of travel for periods extending into weeks of waiting with the expectation of torpedoing certain vessels. Under certain favorable conditions, where the water is less than 200 ft. deep, a submarine might lie at rest on the bottom, and if equipped with sensitive listening-devices attempt to detect the approach of a vessel. As soon as this evidence was secured, the submarine might come to the surface for a quick observation by means of the periscope and in this manner obtain the proper aim that would be required to register an effective hit.

In case the water is more than 200 ft. deep a submarine must be kept in motion to obtain steerage-way in order to hold its proper depth of submergence. This speed may not exceed 4 or 5 miles per hour, but to remain submerged, and at the same time unobserved, the water must be at least 60 ft. deep.

The latest type of submarine that is being used abroad has a surface-speed of at least 17 knots per hour and a submerged-speed of probably less than 10 knots. The superior gun-fire from the merchantman which has been properly equipped would make it necessary for the submarine-commander to obtain his observations, such as would permit accurate aiming of the torpedo, during the brief interval of time required to come to the surface for observation through the periscope and to submerge again.

If running near the surface, the periscope might be raised, a quick observation taken, and lowered again within 30 seconds. If, however, the submarine is on the surface and hatches uncovered, from one to four minutes will be required to submerge completely, depending upon circumstances.

A submarine of recent type probably has a total

*Bulletin No. 1 of the Naval Consulting Board of the United States.

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radius of action of as much as 8000 miles when traveling at a moderate cruising speed of from 10 to 11 knots, and may remain away from its home-base for as much as one month, without requiring either fuel or other supplies during this period.

This type of submarine may have as many as three periscopes, two conning towers, and two rapid-fire guns attached to the upper part of its hull.

The vessel is steered by efficient gyroscopic compasses, which are unaffected by extraneous magnetic or electrical influences.

A general understanding of the capabilities of the modern submarine for offensive operations will make it easier to appreciate the importance of the three problems that follow.

Means for Discovery

When the condition of sea and air is favorable, a submarine is readily discernible from an aeroplane flying at a sufficient height even though the former be submerged to a considerable depth.

While aeroplanes have been used successfully in the English channel, they are unable to fly far at sea, where submarines are now most active. Mother-ships for carrying and launching aeroplanes might be used in this connection, but there are only a small number of such ships in operation, and the construction of others under present conditions is necessarily a slow process.

Various sound-recording devices, intended to discover surface-vessels, submarines, and even moving torpedoes, are now being tested carefully. Water is an excellent conducter of sound, and the development and improvement of such apparatus offers a promising field for inventive endeavor to those who possess adequate scientific training and laboratory facilities.

Many devices are suggested which depend upon optical means of detection, such as special forms of telescopes and field-glasses to be mounted on ships, or on scouting-vessels. Many special forms of search-lights and projectors have been suggested. The fact that a moving torpedo leaves in its wake a stream of air-bubbles caused by the exhaust-air from its propelling engines, offers, under favorable conditions, one means for discovering the approach of a torpedo. This evidence is, however, difficult to detect in a rough sea or at night, and, furthermore, the bubbles do not reach the surface of the water until after the torpedo has travelled onward a distance of from 50 to 200 ft. toward its target.

The dragging of trawls, or nets, by special guard-boats, not only with the view of discovering submerged submarines but also to sweep up floating and stationary mines, is frequently suggested. Under certain conditions this operation is practicable and effective.

It will be seen that each of the above methods, however useful, has its limitations, and scientists and inventors should apply themselves not only to the task of improving these, but also of finding supplementary methods and devices.

Protection of Cargo-Carrying Ships by Nets or Screens

Many designs of such devices are suggested. Most of them are intended to be attached to the hull of the vessel to be protected. Many other suggestions along these lines, and differing only in some of their minor characteristics from the foregoing, have been received by the board. Up to the present time not one of the proposals involving screens of any kind has received the approval of the Navy Department or of the Merchant Marine. The principal objections offered to these devices are that they are heavy, difficult to hold in position, unmanageable in a heavy sea, and that they interfere with the speed and with the ability of the vessel to manoeuver. The undeniable evidence which has been accummulated during the past few months of submarine activity has demonstrated that the immunity of a vessel to submarine attack is dependent largely on its speed, and also on its manoeuvering ability. The proportion of vessels having speeds of 15 knots or more which have suffered from submarine attack is small, while the loss of slow vessels, whose speed is less than that of a submerged submarine, amount to practically 100% of those attacked. Many of the suggested devices would prevent the launching of life-boats or rafts from the vessel to be protected. It is possible, however, that there may be developed some form of this general plan which will be found practicable. In no other field have so many suggestions or so many duplicate inventions been presented.

Protection Through Invisibility

A submarine being close to the water, the position of a vessel at a distance can only be determined by observing its smoke, which floats high in the air. Improved smokeless combustion is therefore desirable. Relative invisibility may also be afforded by methods of painting. Suggestions as to any other methods of reducing the range of visibility will be of interest.

Destruction and Blinding of the Submarines

A rapid-fire gun is effective when the submarine is seen within accurate range of the gun; but the target is so small that it is difficult to hit.

The powerful effect of any submarine explosion on all neighboring bodies provides a simple means of destroying or crippling an under-sea boat. Once its position has been even approximately ascertained, the setting-off of a heavy charge of high explosive, well submerged in the vicinity of the submarine, will bring about this result.

In certain areas, a quantity of heavy black petroleum or similar substance which will float on the surface of the water has proved an effective means of clouding the optical glass in the periscope's exposed end.

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Under favorable conditions of wind and position, many vessels have saved themselves from torpedo-attack by the production of a smoke-screen. This may be formed either by incomplete combustion of the oil used for fuel by most naval vessels, or it may be created by burning chemicals, such as phosphorus and coal-tar, or mixtures in which both of these and other materials are used.

After hiding itself from the submarine in a cloud of dense smoke, the vessel, if possessed of sufficient speed, may be able by a quick manoeuvre to change her position and escape before the submarine is able to discharge a torpedo.

Mines and Torpedoes for Naval Operations

Mines. Ever since the first use of gunpowder in the prosecution of war, mines and torpedoes have received great attention from the warrior and the inventor. Mines are either fixed or floating. The fixed or stationary submarine mine is fired by contact, electricity, timing-device, or fuse. Such mines, which are extensively used by all navies, are rugged in design and may contain large charges of explosives. They are placed in position by especially equipped mine-laying vessels. Such a mine is provided with an anchoring-device.

Floating mines differ from fixed mines in that they are unanchored, and, unless guard-boats are at hand to warn friendly vessels of their proximity, may be as dangerous to friend as to foe. Such mines must be, according to laws of war, designed to become inoperative within a few hours after being set adrift.

Torpedoes. The modern submarine torpedo is about 20 in. diam. and 20 ft. long; is self-propelled; is not steered by magnetic means; and keeps a fairly accurate course for several thousand yards at an average speed of more than 30 miles per hour. Its weight is approximately a ton and a quarter. When traveling at normal speed, it possesses great momentum. In fact, in one case, when the high explosive charge in the 'war-head' failed to detonate properly, the body of the torpedo penetrated the steel hull of the ship attacked Torpedoes are also provided with means to cut through screens, nets, or guards placed in their path.

A torpedo is projected from a submarine or other vessel by means of a special form of tube or gun. A small charge of gunpowder or compressed air is employed to start the torpedo, after which, if of the usual self-propelling type, it is driven through the water by its own compressed-air motor, the air being supplied from a strongly built reservoir within the body of the torpedo itself. The torpedo is kept upon its course by a gyroscope steering-mechanism, which is immune to outside magnetic disturbances.

The detonation of the torpedo is accomplished through a mechanism placed within its war-head; and if the torpedo is either abruptly diverted from its course or is checked in its forward motion, the firing-device, which is operated by arrested momentum rather than by any form of a projecting firing-pin, instantly ignites the heavy charge of explosive contained within the war-head. The explosion, if it takes place within 20 ft. of the vessel, will usually rupture the ship's plating, because of the terrific blow transmitted through the water from the point of the explosion to the ship's side. The depth at which a torpedo travels may be regulated and is usually between 12 and 15 ft. below the surface.

Confining the Submarines

The question as to why submarines are not destroyed before they reach the open sea is a natural one, and the best answer that can be given, according to the officers of our Navy and those of the foreign commissions who have visited this country, is as follows:

The submarine-bases are strongly protected by land-batteries, aeroplane-observers, and large areas of thickly mined waters extending to such distances that the largest naval gun cannot get within range of the bases. In spite of these protections, there is now going on a continuous attempt on the part of the Allied navies to entrap or otherwise defeat the submarines as they emerge from the protected areas. Nets are laid and as promptly removed by the enemy, whose trawlers are in turn attacked by our destroyers. The design of these nets and the detailed arrangement of their fastenings and attachments offer a broad field for invention, but it should be remembered that they must be capable of being used in waters in which there is a tidal current running from two to five miles per hour. Many suggestions for 'bottling up' these bases have been offered.

Ships and Shipbuilding

Many suggestions are made for ships of unusual form to provide for safety in case of a torpedo or mine exploding near or against the hull. Most of these plans are an elaboration of the usual water-tight bulkhead-construction now required for all modern ships.

Multiplication of water-tight compartments in any hull design tends to add to the vessel's safety. The modern tank-steamers used to carry fluid cargoes, such as petroleum products or molasses, is a good example of this design, which has been in general use for many years.

The explosion of a nearby submarine-mine or torpedo frequently tears great rents in the ship's plating, in some cases opening a jagged hole ten feet or more across, but the destructive effect on the hull of a ship caused by the explosion of a mine or torpedo may be greatly diminished by special hull-construction.

From recent experiments and experience, it has been demonstrated that the average merchant-steamer may be seriously damaged by the explosion of a torpedo 35 ft. from its hull, but the destructive effect at any given distance from the point of explosion depends to a large extent upon the design and condition of steel framing and plating. A vessel with a strongly built hull can withstand an explosion that would destroy a weaker vessel.

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Distribution of Pressures Through Earth-Fills*

By A. T. GOLDBECK†

Measurement of the distribution and intensity of pressure under earth-fills resulting from concentrated loads is only one of many phases of earth-pressure measurements on which knowledge is desired by engineers. For carrying on this part of the investigation a special building, having a heavy reinforced concrete floor, was designed and constructed by the Office of Public Roads and Rural Engineering at the Arlington Experimental Farm, belonging to the Department of Agriculture.

The bin for containing the material used in the investigation was 7½ ft. wide and 14 ft. long for all fills above 2 ft. Up to 2 ft. the bin was 7½ ft. square. Only in the case of the 5-ft. fill was the size of the bin increased properly to take care of the pressure distribution. In this case, the side walls interfered with the transmission of the vertical pressure. In the present series of tests a coarse concrete-sand dredged from the Potomac river was used. The sand was tested in its moist condition, as delivered, and was kept moist by daily sprinkling. There was from 3 to 5% of moisture in the sand, enough so that it would stick together when compressed with the hands.

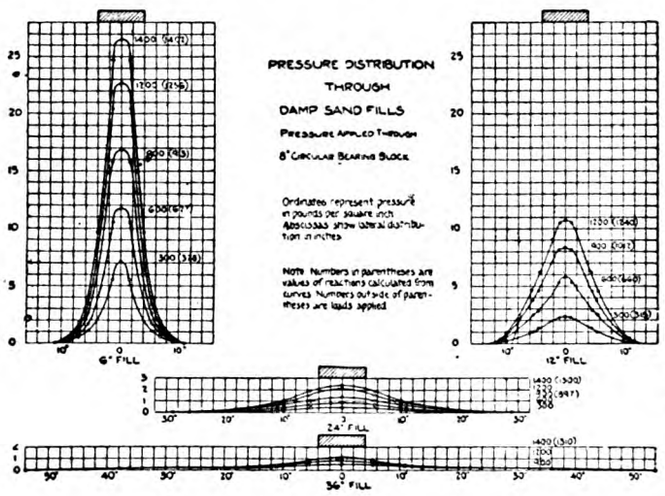

FIG. 1. PRESSURE DISTRIBUTIONS

When the proper depth of fill was obtained, the surface was smoothed and the bearing-block carefully centred over the central measuring-cells. Flat circular bearing-blocks were used, one 8 in. and the other 13½ in. diameter. A calibrated I-beam was used for applying the loads. It was provided with knife-edges and was kept level by means of a screw-jack. By placing a 100-lb. weight in various positions on this I-beam, the different loads could be obtained. Extreme care had to be exercised in placing the bearing-block and in seeing that it remained level. The slightest disturbance from its position over the central cell or its lack of horizontality would show in the readings of the cells adjacent to the centre. Only those readings obtained with the

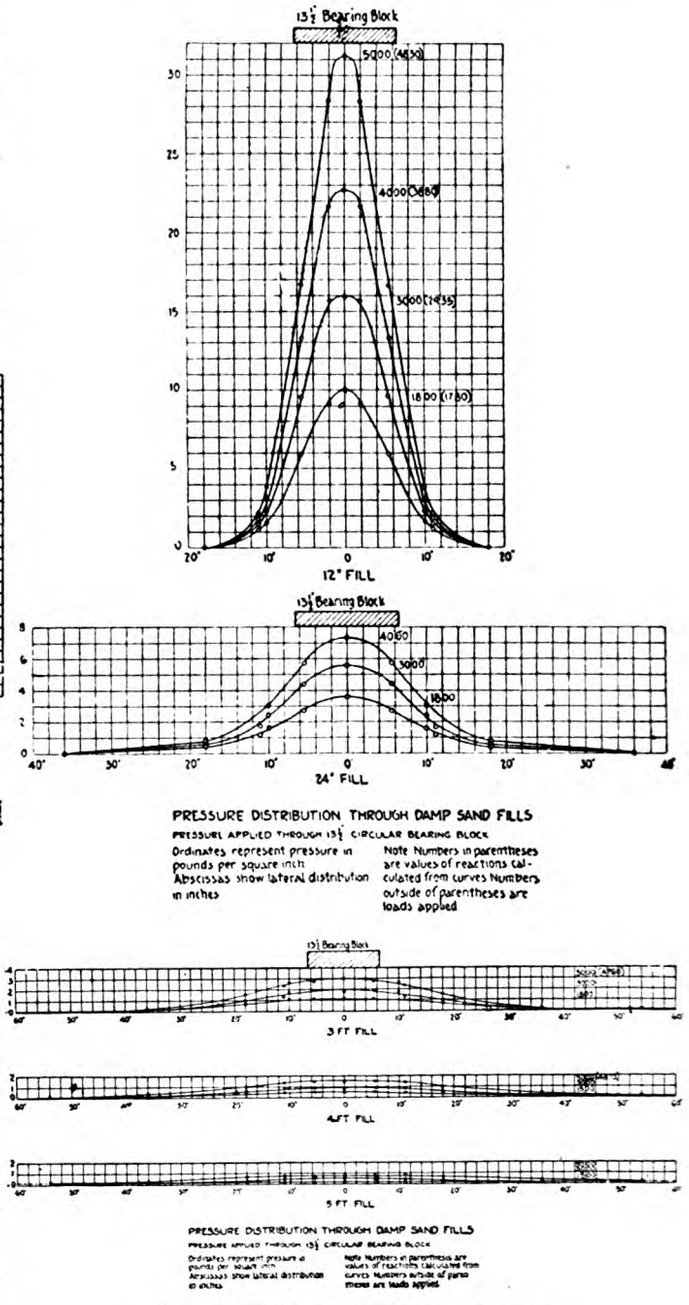

FIG. 2 AND 3. PRESSURE DISTRIBUTIONS

*Abstract of paper read before the American Society for Testing Materials.

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block in as nearly horizontal position as possible were considered in tabulating the results.

The results of the readings are shown in Fig. 1, 2, and 3. The readings resulting from the weight of sand alone were subtracted from the readings obtained when the fill was loaded. The differences were plotted as ordinates. The abscissas represent the lateral distribution of the pressures. Since a circular bearing-block was used, it is to be assumed that the pressures in all lines passing through the centre are identical with those measured. The reactions have been calculated for a number of the applied loads, and are shown in parantheses on the curves. The loads applied are shown outside of the parentheses. Theoretically they should be identical, and actually they are nearly equal.

The tests were made under conditions which resemble those in a road-slab having an earth covering. In the design of such a slab, the engineer is primarily interested in the amount of distribution of a concentrated load furnished by the earth-fill. He would like to know the lateral distribution in order that he might figure what width of slab carries the load. He would also like to know the distribution forward or backward from the wheel-load in order that he might determine the moment about the concentrated load of the distributed pressure-load, and thence obtain the bending-moment.

It is common practice at the present time to assume

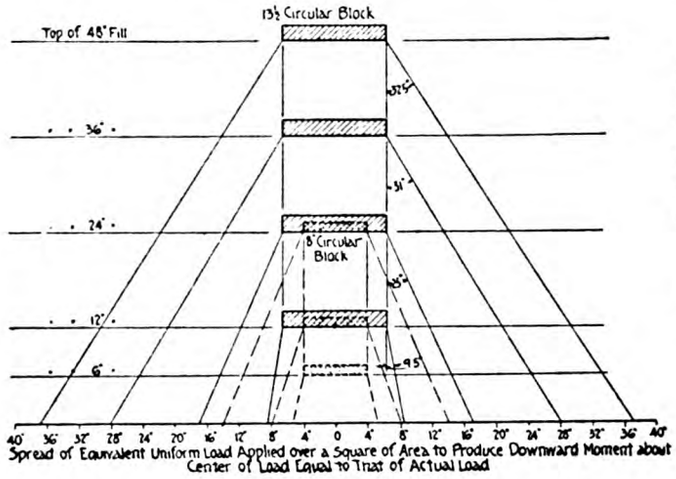

FIG. 4. EQUIVALENT SQUARES OF AREA

that a wheel-load acts over a definite area on top of the fill, that the pressure is transmitted with uniform intensity to the slab, and that it acts over an area determined by an assumed angle of spread from the top of the fill. This assumption of uniform intensity is, of course, wrong, as shown by these pressure-measurements, but forms a convenient means of calculation provided the correct intensity and area of pressure are assumed. In order to make use of the curves of pressure for practical calculations of bending-moment, it would be well to know the position of the centre of gravity of the half-volume of the figure generated by revolving the curve about its central axis. The distance from the centre of gravity to the centre of the curve, multiplied by one-half the total load, is the moment about the wheel-load of the distributed pressure on either side of that load. The centres of gravity of these half volumes for the maximum loads applied to the various depths of fill have been calculated, and are shown in Table I.

If, for the convenience of the designer, the pressure at the bottom of the fill is considered uniform and acts over a square of area, the sides of each of these areas will be equal to the values in the last column of the preceding table multiplied by four. The sides of the squares of areas thus obtained are somewhat different for the highest and lowest loads applied and may be tabulated as in Table II.

TABLE I. POSITION OF CENTRE OF GRAVITY OF HALF OF PRESSURE ON SLAB WITH RESPECT TO CENTRE OF LOAD

Depth of fill, in.	8-in block: Load, lb.	8-in block: Centre of gravity to centre of load, in.	13½-in. block: Load, lb.	13½-in. block: Centre of gravity to centre of load, in.
6	1400	2.6	....	...
12	1200	3.6	1800	4.4
			5000	4.2
24	1400	7.0	1800	10.5
			4000	8.4
36	1400	16.8	1800	16.0
			5000	14.0
48	....	...	5000	18.5

The results in Table II, for the high-loads only, are shown graphically in Fig. 4. In calculating the bending-moment in a slab, the designer, instead of using the varying intensity of the load, as it is shown to exist in the pressure-measurements, may consider the same total pressure applied over a square of area whose side is given in Table II or as shown in Fig. 4.

TABLE II. EQUIVALENT SQUARES OF AREA

Depth of fill, in.	Load on 8-in. block, lb.	Length of side of square uniform pressure-area, in.: 8-in. block	13½-in. block	Load on 13½-in. block, lb.
6	1400	10.4	...	....
12	1200	14.4	17.6	1800
			16.8	5000
24	1400	28.0	42.0	1800
			33.6	4000
36	1400	67.2	64.0	1800
			56.0	5000
48	....	...	74.0	5000
60	....	...	...	....

It is recognized that in order to give complete data on this problem, several other kinds of filling-material should be investigated, and bearing-blocks shaped and spaced like wheels and rollers should also be applied to the fill. This will be undertaken in the investigation still under way, as well as the question of lateral pressures produced by vertical loads.

Sulphuric acid and other electrolytes increase the surface-tension of water, but this increase is negligible unless acid is added in strong proportions.

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Flow Conditions in Flumes*

By JOHN S. LONGWELL†

In connection with experimental investigations made on the North Platte project during the irrigation season of 1916, several observations were made of flow-conditions at the Congo flume on the Low-Line canal. These observations were made primarily for the purpose of determining the inlet and outlet losses and the value of Kutter's n for the flume. However, studies made of the data submitted revealed an interesting and important condition of flow separate from the original objects of the investigations.

The flume under consideration is of the semi-circular steel type, with smooth interior, known commercially as a Hess No. 204. The inside diameter is 10.823 ft. It is constructed on a tangent and has a total length between head-walls of 240 ft. The field-observations consisted of:

1. Profile of water surface.
2. Profile of sub-grade.
3. Elevation of top of flume.
4. Measurement of discharge through the flume.

The observations made on July 20, 1916, were taken as representative of flow-conditions. Fig. 1 has been prepared on which are shown in full lines the profiles of actual sub-grade, actual water-surface, and the top of the flume. The discharge through the flume at the time of making the above observations was 235 cu. ft. per second.

An examination of the water-surface profile shows that the flow through the flume is decidedly unstable, especially at the upper and lower ends of the flume. This general unstable condition of flow, together with the decided drop and jump in the water-surface at the lower end, was identical in each test made and led to the belief that the flow must be at or near the critical depth. To substantiate the above theory studies have been made of the flow conditions throughout the flume.

With a discharge of 235 second-feet, various depths in the flume were assumed and the resulting area, velocity, and velocity-head for each depth computed. These data were plotted (see Fig. 2), with the depths in the flume as abscissae and the energy required to maintain the flow at these depths as ordinates. The energy required is equal to $D + h_v$ where D represents static head and h_v velocity-head. The resulting energy-curve for a flow of 235 second-feet through the flume was then drawn.

From the shape of the curve it follows that there are two depths at which the flow will take place with the same energy. These two depths are known as the lower alternative stage (stage of high velocity) and the upper alternative stage (stage of low velocity). The curve also demonstrates that there is one depth at which the two stages merge, this being the lowest point on the curve and hence the depth of flow requiring the least energy. This depth is known as the critical depth.

As the depth becomes less than the critical, the flow is taking place at the high velocity of the lower alternative stage, and if obstructed will jump and flow under the condition of the upper stage of low velocity. With the flow taking place at or near the critical depth, as shown by the flatness of the curve at this point, any slight change in energy will cause a decided change in the depth. It is thus to be expected that in such a case the water-surface will be rough and the depth will shift back and forth along the curve. A jump may be expected if the flow is at all restrained.‡

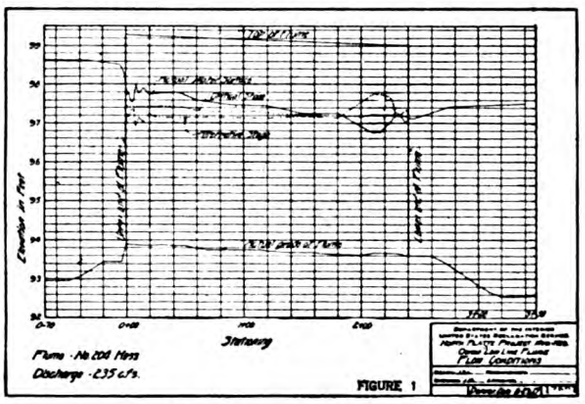

FIG. 1. FLOW-CONDITIONS IN CONGO FLUME

The velocity at which the water will flow at the critical stage is termed the critical velocity and may be shown to be equal to $V = \sqrt{g\frac{A}{T}}$, the corresponding velocity being $h_v = \frac{A}{2T}$, in which

V = critical velocity,
g = acceleration due to gravity,
A = cross-sectional area of flume,
T = width of water-surface.

From this formula the depth at which the critical velocity is developed may be obtained. For the case in hand this was found to occur at a depth $D = 3.54$ ft. with a velocity of 9.09 ft. per second. Thus we have the co-ordinates for the critical stage as follows: $D = 3.54$, $D + h_v = H = 4.82$. These were plotted and furnished the lowest point through which the energy-curve must pass.

Having obtained the critical depth, $D = 3.54$ ft., the

*From 'Reclamation Record.'

†Assistant engineer, U. S. Reclamation Service, Denver, Colorado.

‡See Transactions of American Society of Civil Engineers, Vol. LXXX, pp. 338-420, for a complete description of the above principle.

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dotted line indicating this depth of flow throughout the flume was plotted on Fig. 2. This line shows the critical stage. It was observed that the actual water-surface for the test was close to the critical stage throughout the flume. From the explanation given above it follows that an unstable condition of flow was to be expected.

As stated above and as is shown by the energy-curve, there are two stages at which the flow will take place for any definite energy. In Fig. 1 the actual water surface is taken as one stage and for each observed elevation the opposite stage is taken from the energy-curve and plotted. These points are then connected and this line represents the alternative stage at which the water could have flowed in this particular flume with the same energy with which the flow actually took place.

It is observed that up to station 1 + 83 the flow takes place at the upper alternative stage, but that the actual was so close to the critical stage that the flow was rough

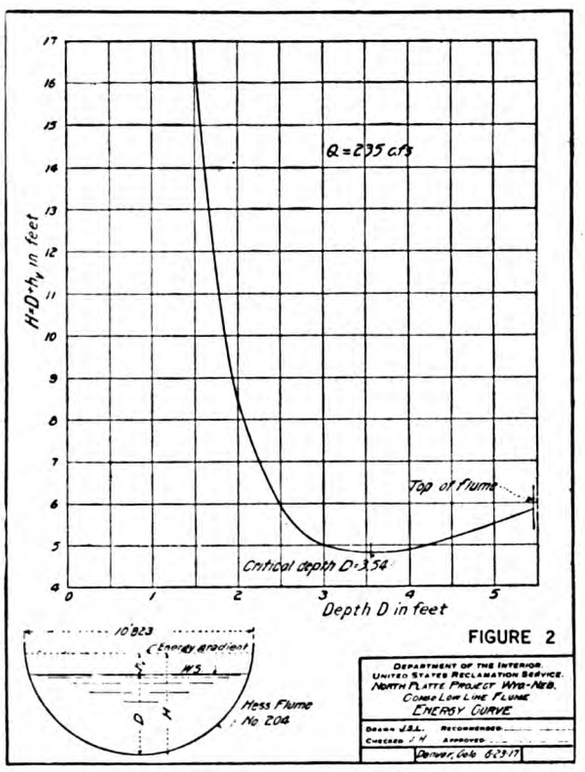

FIG. 2. ENERGY-CURVE

and unstable, and with a slight change of energy could easily have shifted to the high velocity or lower alternative stage. At station 1 + 83 the flow-line drops below the critical stage and assumes the lower alternative stage. At station 2 + 30 the flow jumps to a point near the critical stage and then drops again to the lower stage. This rise at station 2 + 30 was probably caused by the rise in the sub-grade. Had this rise in sub-grade been a little more pronounced the flow-line would have taken approximately the elevation 97.78 as shown for the alternative stage.

The above data show the unstable conditions of flow which may be expected to take place in a flume with the water flowing at or near the critical stage. The necessity for consideration of the above principles in connection with flume-design is apparent. It is believed that for all flumes in which the water is flowing at a high velocity, similar investigation should be made before final designs are prepared. In case of flow at or near the critical stage, additional freeboard should be provided.

COMPARATIVE VALUE OF CANALS AND OF RAILROADS FOR FREIGHT TRANSPORTATION

In a paper presented before the American Institute of Electrical Engineers, Lewis B. Stilwell compares the first cost and operating expenses of canals and railroads of similar carrying-capacity. Exclusive of the Panama Canal, the aggregate lengths of canals for navigation built by the Federal Government is about 1400 miles and the average cost, $80,000 per mile. The average reproduction cost of a single-track railroad as fixed by the State commissions in Wisconsin, Minnesota, and Michigan is about $40,000 per mile.

In comparing freight-carrying capacity and power consumption, the canal of the Lehigh Coal & Navigation Co. between Coalport and Bristol, Pennsylvania, and the electrified part of the New York, New Haven & Hartford Railroad were taken as examples. The canal is 106.2 miles and has 70 locks. The barges used in the test weighed 24 tons empty, and carried a load of 113 tons. About 33 watt-hours were required per freight ton-mile, using four-barge tows. The traffic-capacity of the canal, assuming that all existing locks were changed to accommodate four barges, is 72 boats or 8150 tons per 12-hour day, with a 40-minute interval between tows.

On the electrified part of the New York, New Haven & Hartford Railroad, during October and November 1914, the energy-consumption per ton-mile of train-weight was 27.3 watt-hours for slow freight, average speed 10.85 miles per hour, and 28.5 watt-hours per ton-mile for fast freight, average speed 18.2 miles per hour. As the freight-runs on this part of the road are short, the power-consumption is high, as it may safely be stated that under average conditions for double-track railroads in the United States on a run of 100 miles, the power required to maintain an average speed of 18 miles per hour would not be greater than that required on the canal for a speed of 1.25 miles per hour.

As regards carrying-capacity, a double-track railroad, which would probably cost considerably less per mile than the canal, could carry considerably more freight. A 2500-ton train would carry about 1600 tons of freight. To equal the capacity of the canal, it would only be necessary to run five such trains in 12 hours. This would give a headway of 2 hours and 24 minutes, while it would be possible to run trains on a 30-minute or even a 15-minute headway.

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The Madera Irrigation Project

The construction of an irrigation system supplying 300,000 acres of land in Madera county, California, has been proposed. Part of this land is now irrigated by gravity canals taking water from the Fresno river and other small streams without storage, part of it is irrigated from individual pumping-plants, and most of the remainder is 'dry-farmed' to grain. It is proposed to construct a reservoir on the San Joaquin river near Friant, also to use the natural flow of the Fresno and Chowchilla rivers, and in addition to obtain water from pumping-plants. A temporary organization has been formed, rough preliminary surveys made for reservoir-sites and canal-routes, and Louis C. Hill, consulting engineer for the U. S. Reclamation Service, has prepared a report upon the project. This article is based upon Mr. Hill's report.

The dam for the main storage-reservoir would be on the San Joaquin river near the terminus of the Southern Pacific Railroad at Friant. No borings have been made at the site and this should be done before proceeding further with the design of the system. However, it seems probable that bedrock is near the surface. The proposed dam would be 290 ft. high from foundation to parapet, and would contain 1,200,000 cu. yd. concrete. It is estimated that portland cement will cost, delivered at the dam-site, $2.10 per bbl. Allowing for a liberal use of 'plums' and lean concrete in the body of the dam, it is estimated that the concrete will cost $4.30 per cu. yd. No power-plant would be needed at the dam, as power could be purchased from the San Joaquin Light & Power Co. The following preliminary estimate of the cost of the dam has been prepared:

Preliminary expense, surveys, topography, etc.	$ 1,500
Borings, test-pits, etc.	25,000
Right-of-way	250,000
Excavation for dam	400,000
Portland-cement masonry, 1,200,000 cu. yd. at $4.30	5,160,000
Cement-gun work	15,000
Grouting	30,000
River-diversion	40,000
Spillway	300,000
Roads	10,000
Extension of railroad and side-tracks	50,000
Hospital	10,000
Liability insurance	30,000
Power sub-station	15,000
Camp expenses	30,000
Gates, etc.	400,000
Pumping, lighting, etc.	10,000
Drainage in dam and drilling for drainage	15,000
	$6,805,000
Overhead not included in above	150,000
	$6,955,000
Interest during construction	800,000
Total cost with portland-cement concrete	$7,755,000

If sand-cement, such as was used in the construction of the Elephant Butte dam, is employed, the cost can be reduced to $6,755,000.

The storage-capacity of the reservoir would be 300,000 acre-feet. Reliable records of the flow of the San Joaquin river have been kept since 1910, and of Kings river, a similar stream as regards watershed and general conditions of flow, since 1896. Hydrographs were constructed from the San Joaquin River records, and by comparison, from the Kings River records. The 21-year record thus obtained showed, after allowing for the prior claims of Miller & Lux, that a yield of 400,000 acre-feet per year could have been obtained during 18 of the 21 years in question. During the driest of the 3 remaining years, a yield of at least 300,000 acre-feet could have been obtained.

In addition, a minimum of 60,000 acre-feet per year could be obtained from Fresno and Chowchilla rivers. When the demands on the system become greater, it will probably be advisable to construct a reservoir on the Chowchilla river, and also to divert the waters of Fresno river at a point below Fresno Flats by means of a flume and canal one mile long, and a small tunnel 5000 ft. long through the ridge dividing the Fresno and Chowchilla watersheds. It may also be advisable to construct a reservoir on Fresno river at Fresno Flats. When these storage-works have been constructed the safe yield of the two rivers will be increased to 120,000 acre-feet per year.

Ground-water is close to the surface through most of the proposed district. In fact in some places it is so close as to interfere with proper drainage. It is proposed to construct pumping-plants that will yield 150,000 acre-feet per year. The proper handling of these plants will also prevent land being ruined by seepage and solve the drainage-problem. Since all the lands in the district will not be irrigated at first, the gravity-supply will be sufficient for some time to come, but it will be advisable to construct the pumping-plants as soon as the matter can be arranged, mainly on account of seepage and drainage conditions.

Allowing a 25% loss for the San Joaquin River water in transmission from the point of diversion to the farms, a slightly smaller loss for the Fresno and Chowchilla water, and assuming that the entire amount pumped will be delivered, the amount actually available per year for irrigation is as follows:

	Acre-feet
From San Joaquin river	300,000
From Chowchilla and Fresno rivers	50,000
From pumping-plants	150,000
Total	500,000

From records of the Fresno Canal & Irrigation Co. for

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land under similar general conditions, it would appear that two acre-feet per acre is sufficient, making the available supply enough to irrigate 250,000 acres. Since not all of the land in a district is ever irrigated in one year, on account of the area occupied by roads, farmyards, dwellings, pasture-land, etc., it will be safe to provide for a district of 300,000 acres. By constructing storage-reservoirs on the Fresno and Chowchilla rivers, and increasing the amount obtained from pumping-plants, it is believed that a district containing 350,000 irrigated acres or 400,000 acres in all, could be served.

The main canal would have a capacity of 2500 second-feet at the point of diversion, decreasing in size gradually. The total cost of the canals and laterals is estimated at $3,600,000. By making the permanent structures full-size, but making the main canal and principal laterals smaller than their final capacity, it is estimated that $500,000 can be saved on the first cost. The canals can be enlarged with a drag-line excavator as the increasing demand for water makes it necessary.

The estimated first cost of the proposed system is as follows:

Canals and laterals	$3,100,000
Interest during construction of canals	300,000
Main dam	7,755,000
Total	$11,155,000

Assuming 300,000 acres in the district, this would give a cost of $37.20 per acre. If sand-cement is used in the construction of the main dam, this first cost can be reduced to $10,155,000, or $33.85 per acre.

During the early years of the project, when the demand for power at the pumping-plants is comparatively small, it will probably be best to purchase power. Later, when the demand becomes greater, power can be generated at the various storage-reservoirs.

GOPHER-CONTROL ON THE SALT RIVER PROJECT

Control of gophers and other burrowing animals is discussed in the *Reclamation Record* by A. J. Haltom, irrigation manager on the Salt River project. Lining ditches with concrete is effective, but frequently the expense is prohibitive. Trapping and poisoning usually dispose of only a small proportion of the total number of animals. Pasturing sheep and goats on the canal banks is much more effective and frequently eliminates most of the trouble.

Another satisfactory method is to dig a narrow trench 3 or 4 ft. deep along the bank of the canal, parallel with the canal and from 2 to 4 ft. from the line of high-water mark. In this trench is placed ½-in. mesh galvanized wire, the top of the wire being a few inches above high-water mark and the bottom of the wire at the bottom of the trench. The depth of wire required depends upon the height of the banks. The trench is then filled and tamped. The gophers cannot cut through the wire and therefore cannot get through the canal bank. Old iron roofing, steel plates, or similar material could also be used. The cost of this method of protection is from 20 to 30c. per foot.

COST OF DREDGING AT PANAMA

The work of the three large dipper-dredges, 'Gamboa,' 'Paraiso,' and 'Cascadas,' constructed by the Bucyrus Co. for work on the Panama Canal, is described in the 'Proceedings' of the American Society of Civil Engineers by R. W. Berdeau. The 'Gamboa' and 'Paraiso' had a displacement of 1730 tons, while that of the 'Cascadas' was 2095 tons. The total cost of the first two dredges, including towing to the canal, was $578,166.11, and the cost of the 'Cascadas' was $376,-180. Each dredge was supplied with a 10-yd. and a 15-yd. bucket, but on account of the dredges being used in rock in the Gaillard cut, the 10-yd. buckets were used almost exclusively. The buckets were of cast manganese-steel. The records given for each dredge are up to and including September 1916. All the dredges worked three 8-hour shifts.

The 'Gamboa' was placed in operation in April 1914. The minimum output per month was 108,185 cu. yd. in May 1914, the maximum, 320,190 cu. yd. in July 1916. The minimum cost was $0.058 per cu. yd. in July 1916, the maximum, $0.263 per cu. yd. in July 1914. The average cost for the entire period was $0.10 per cu. yd. These costs include operation and maintenance, but not interest and depreciation.

The 'Paraiso' was placed in operation in June 1914. The smallest output was in July 1914, 82,203 cu. yd. and the largest, 315,915 cu. yd. in August 1916. The lowest cost was $0.058 per cu. yd. in July 1916 and the highest, $0.282 per cu. yd. in August 1914. The average for the entire period was $0.095 per cubic yard.

The 'Cascadas' was placed in operation in October 1915. The largest output was 340,185 cu. yd. in July 1916, and the smallest, except for September 1916, which seems to have been unusually low, was 203,967 cu. yd. in August 1916. The lowest cost was $0.057 in February 1916 and the highest, also excepting September 1916, was $0.086 in August 1916. The average for the entire period was $0.067 per cu. yd. For the 'Cascadas,' the total cost was almost equally divided between operation and maintenance. For the other two dredges, the division was about 40% operation and 60% maintenance. The total amount excavated by the three dredges for the entire period was about 14,-500,000 cubic yards.

Gasoline from natural gas produced in 1916 in the United States amounted to 104,212,809 gallons, including that obtained from vacuum-pumps and from the drips on gas-transmission lines. This is a gain of 59% over the preceding year. The average recovery per thousand cubic feet of gas was 0.499 gallon.

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Factors Affecting the Strength of Concrete*

By L. N. EDWARDS†

During 1916 a series of tests of concrete specimens was made for the city of Toronto, under my supervision, with the objection of securing information relating to the effect, first; of the grading of sand; second, of varying the consistence of mix; and, third, of varying the time of mixing. As far as possible, the proportioning and mixing of the concrete and the preparation of test-specimens was done under conditions similar to those accompanying actual field construction under good supervision.

Samples were taken of 12 different local sands and these were re-graded and mixed according to the following arbitrary gradings:

TABLE I. PREDETERMINED GRADINGS FOR SANDS

Series No.	Sand No.	Percentages retained on sieves No. 10	No. 20	No. 50	No. 100
1	1	15	35	80	97
	2	20	50	85	97
	3	25	60	95	97
2	4	15	40	85	97
	5	20	45	85	97
	6	30	60	85	97
3	7	20	40	85	97
	8	25	45	90	97
	9	30	50	95	97
4	10	25	55	80	97
	11	25	55	85	97
	12	25	55	95	97

The crushed rock used was a uniformly dense, dark-colored limestone, with 43.85% voids. Material passing a ¼-in. screen was removed. Of the remainder, 18% passed a ½-in. screen, 45%, a ¾-in. screen, and 68%, a 1-in. screen. The maximum size was approximately 1¼ inch.

The ingredients for a one-bag batch were proportioned by weight as follows:

	Mixture 1:2:4	Mixture 1:2½:5
Cement, lb.	87.5	87.5
Sand, lb.	186.5	233.4
Stone, lb.	312.6	391.2

The amount of water to be used was determined as follows: A so-called 'first consistence' was assumed, such as would produce concrete in which the stones were covered with a thick coating of sticky semi-plastic mortar, such concrete as could be transported in wheelbarrows without appreciable segregation of the materials, and which would settle into place in the forms with a comparatively small amount of tamping. Having determined the quantity of water required for the first consistence, the amounts of water for the second, third, fourth, and fifth consistences were fixed at 110%, 120%, 135%, and 150%, respectively, of the amount for the first consistence. For the first consistence, and a 1:2:4 mixture the amount of water was 6.48% of the total weight of cement and aggregate, and 43.36% of the weight of cement in the case of reinforced concrete beams, and 6.17% and 41.14% for the plain concrete cylinders. For the 1:2½:5 mixture, the corresponding figures were 5.99% and 48.76% for the cylinders. No beams were made from this mixture.

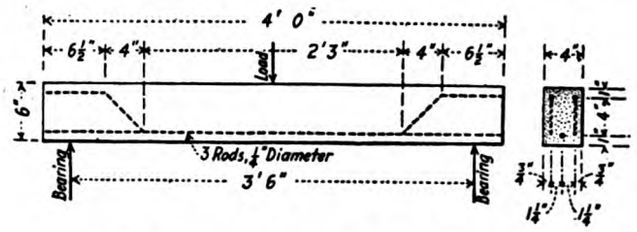

FIG. 1. REINFORCED CONCRETE BEAM USED IN TESTS

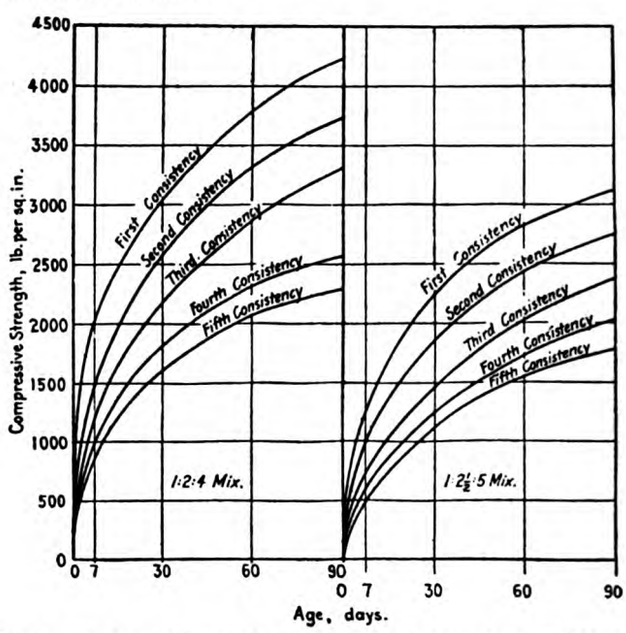

FIG. 2. COMPRESSIVE STRENGTH OF TEST-CYLINDERS OF DIFFERENT CONSISTENCES

A steam-operated ⅛-yd. Foote mixer was used. Bars from $\frac{5}{16}$ in. to ⅜ in. diam. flattened at one end to form a comparatively thin blade were used for tamping. All molds were filled at the mixer and then removed to the storage-shed, 100 ft. away. Test-specimens were made of concrete that had been mixed ¼ minute, ½ minute, 1 minute, and 2 minutes. Except where

*Abstract of paper presented at the annual meeting of the American Society of Testing Materials.

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the concrete set unusually slowly, the forms were removed from the specimens 24 hours after filling.

Test specimens were made of cylinders 6 in. diam. and 12 in. long and of beams 4 by 6 in. by 4 ft., reinforced as shown in Fig. 1. Tests were made of the cylinders at 7, 30, 60, and 90 days, also at one year. The one-year test was omitted in the case of the beams. The results of the tests are shown in Fig. 2, 3, 4, and 5.

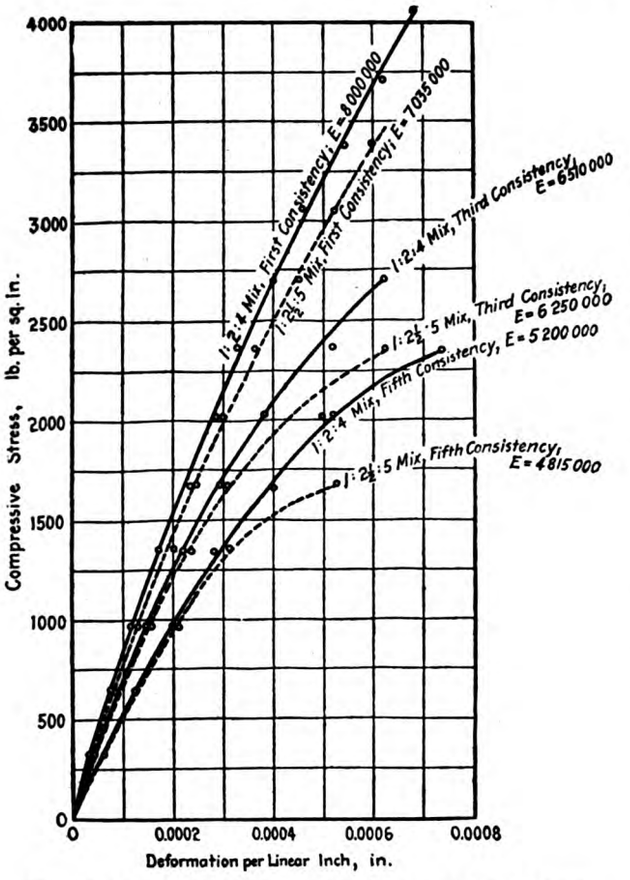

FIG. 3. COMPRESSIVE TESTS UPON CYLINDERS OF VARIOUS CONSISTENCES

In the tests of cylinders three forms of failure were observed, as follows:

1. Double-cone, resulting from a uniform distribution of materials.

2. Diagonal shearing, resulting from the distribution of stone in a manner producing cleavage-planes. Occasionally a wedge-shaped stone may be so placed as to cause a double-wedge fracture.

3. A general 'mushing down' or disintegration of the entire structure at its mid-length. This form of failure invariably indicates a failure of the mortar-content of the concrete.

Although the three forms of failure were common to all tests for grading of sands, it was found that the third was more generally characteristic of low-strength concretes.

In the tests for consistence of mix, the first and second were the forms of failure for the first and second consistences, while the third was the general form of failure for the fourth and fifth consistences.

Critical failure of beams of first and second consistences was usually accompanied by the appearance of several vertical cracks in the middle-third length of the

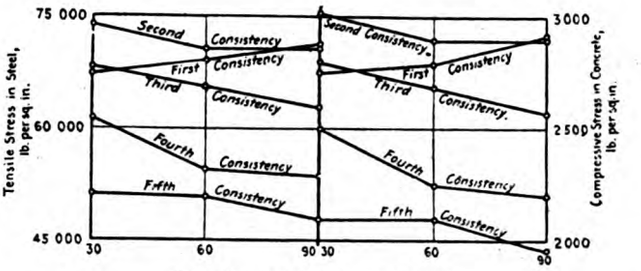

FIG. 4. STRESSES IN BEAMS

beam. A further application of the load caused one of these cracks to widen. Ultimate failure was produced by the breaking of the two outer (bent) bars of the reinforcement and the slipping of the middle bar. Compression in the concrete caused little or no failure of the same by crushing.

Critical failure of beams of the third consistence was similar to that in the first and second consistences, except that crushing of concrete adjacent to the point of application of the load was more common.

Critical failure of beams of the fourth and fifth consistences was accompanied by the appearance of a smaller number of vertical cracks. Usually two of these cracks developed simultaneously for a time, producing a wedge-like block in the centre of the beam. Ultimate failure of beams of the fourth consistence was commonly produced by the breaking and slipping of the reinforcement on one side of the wedge, but in

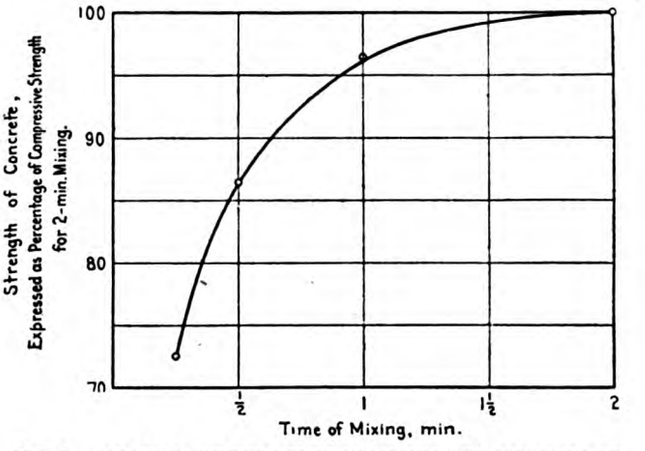

FIG. 5. RELATION BETWEEN TIME OF MIXING AND STRENGTH OF CONCRETE

some cases was the same as for beams of the fifth consistence. Ultimate failure of these latter beams was produced by a spalling of the concrete below the reinforcement at the centre of the beam. In beams of both these consistences, compressive stresses produced a distinct crushing of concrete adjacent to the point of application of the load.

Examination of a number of specimens of different consistences by sawing them apart showed that the smallest number of voids and cavities was found in

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the specimens of the first consistence, also that the best adhesion between the concrete and steel was for this consistence.

The following conclusions are given:

1. The usual 'visual-examination' test of sand for concrete is generally unreliable, since it gives at best only a superficial knowledge of the cleanness of a given sand. Its adaptation to the determination of grading could be of value to the observer only after long experience in the granulometric analysis of sands.

2. The generally accepted practice of proportioning a concrete mix by volume, as, for example, 1 part cement, 2 parts sand, and 4 parts broken stone, is impracticable and unscientific, since it does not take into account the adaptability of the grading of a given sand to the production of a dense, strong, and reliable concrete.

3. The strength, toughness, and durability of the concrete to be secured from the use of a given sand can be determined only by an actual test of that sand in a properly prepared concrete.

4. In field operations incident to spading, slicing, or otherwise compacting the concrete, the movement of the water-content of the mass is intensified, whenever the sand contains insufficient fine material to hold the cement in suspension by the formation of an adequate amount of sandy paste. The free movement of the water tends to produce an improper distribution of the cement.

5. The use of a quantity of water sufficient to produce a concrete, the mortar-component of which is of a saturated, sticky, semi-plastic consistence, is required for most practical purposes, in order to facilitate economical and efficient placing. This quantity of water is ample for the development of the proper functions of the cement. An increase in the quantity of water used results in a proportionate decrease in the strength of the concrete. This decrease is in no sense a function of the proportions of the mix.

6. The excess water in an over-saturated concrete necessarily occupies space and thereby increases the mass. By reason of its high surface-tension, it forms water globules which, although somewhat affected by the weight of the concrete, are nevertheless distributed throughout the mortar and are accumulated underneath the particles of sand and stone and the reinforcing-steel. By evaporation, this excess water ultimately disappears, leaving a considerable volume of voids and cavities, which constitute an important factor in decreasing the strength and reliability of the concrete.

7. The critical failure of reinforced concrete depends upon the intensity of the bond existing between the concrete and the steel reinforcement. Concrete containing an excess of water not only develops less surface-contact with the steel on account of the resulting increase in the volume of voids and cavities; but, in addition, the excessive laitance produced by the water tends to accumulate around the reinforcement, thus contributing materially to a decrease in strength. This condition becomes further aggravated by reason of the tendency of the laitance to become less resistant with age.

8. For the various grades of concrete, the minimum ultimate strengths assumed in the modern practice of plain and reinforced-concrete design are not assured by the commonly specified requirements for sand and stone. The present lack of uniformity and efficiency in field methods and operations aggravates this conditions.

9. The results obtained showed no definite relation between the compressive strengths of 1:3 mortar cubes, and the compressive strengths of the concretes produced from the same sands.

BRAKES ON MOTOR VEHICLES

Retardation was discussed by John Yunger, engineer for the truck department of the Pierce Arrow Co. in the 'Proceedings' of the Engineers' Club of Philadelphia. An average value for the co-efficient of adhesion of pneumatic tires to road-surfaces is 0.5. Assuming brakes on all wheels, the retarding force is $0.5W$, where W is the weight of the car. From the inertia formula, $F = \frac{Wa}{g}$, the retardation $= 0.5g$ or 16.1 ft. per second per second. With brakes on the rear wheels, as is customary, the theoretical retardation is 8 ft. per second per second. It is probable that road resistance, wind resistance, and chassis losses, will increase this to 10 ft. per second per second. This is about as rapid a retardation as the average person can stand with comfort. It will be seen that rear-wheel brakes give all the retardation that is safe. For a retardation of 10 ft. per second per second, a car going 60 miles per hour can be stopped in a distance of 387 ft., and in 8.8 seconds.

Where the function of the brakes is not to bring the car to a sudden stop, but to hold it back to a safe speed on a long down-hill grade, the rate of heating of the brake-surface becomes the governing factor. At the top of a hill, a car possesses both kinetic and potential energy. If the car's speed is unchanged when it reaches the bottom, the brakes, plus the road resistance, have absorbed the potential energy.

Assume a hill one-half mile long with a 10% grade. A five-ton truck, with a gross weight of 20,000 lb., has a gravitational component down-hill of approximately 2000 lb. Assuming a road resistance of 50 lb. per ton or 500 lb. in all, the net force tending to accelerate the truck is 1500 lb. If a speed of 10 miles per hour is maintained, the time of descent is 3 minutes. The energy absorbed by the brakes is 1500×2640 ft.-lb. in all, or 1,320,000 ft.-lb. per minute, or 40 hp., or 1700 B.t.u. per minute. Since about 50 lb. of metal, with a specific heat of 0.12, absorbs this energy, enough heat is generated, neglecting radiation, to raise the temperature of the mass from 60° to 900° F. These figures have been verified approximately by experiment.

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Civil Service Laws and Regulations

The San Francisco Association of Members of the American Society of Civil Engineers recently appointed a committee composed of Jerome Newman, chairman, L. S. Griswold, S. G. Hindes, Franklin Riffle, and R. A. Thompson to report on civil-service laws. The conclusions of the committee as expressed in its report appear below:

The San Francisco Association of Members of the American Society of Civil Engineers.

Gentlemen:

Your committee appointed to study and compare the Federal, State, and municipal civil-service laws, to recommend such modifications, changes, or additions to the state and municipal laws as will result in the public good and will attract the best types of engineers to the public service, and to call to the attention of the parent Society the importance of this subject, and, if possible, initiate similar action by the parent Society to investigate more particularly the Federal civil service, herewith submits the following report on the matters assigned to it:

The civil-service laws, rules and regulations of the United States, State of California, and the cities of San Francisco, Los Angeles and Oakland were carefully studied and compared, disclosing a general agreement, the wording in many cases being identical, but with minor differences in some unimportant respects.

The provisions of the leading sections of the various laws which apply to employees in general and to engineers in particular are:

Number and Term of Commissioners

United States—Three, at the pleasure of the President.

California—Three, four-year term.

San Francisco and Oakland—Three, six-year term.

Los Angeles—Five, four-year term.

Method of Appointment of Commissioners

United States—By the President, with the approval of the Senate.

California—By the Governor.

San Francisco—By the Mayor.

Los Angeles and Oakland—By the Mayor, confirmed by the Council.

Employees of the Commission

United States, California, San Francisco, and Los Angeles—Chief examiner, secretary, and office employees.

Oakland—Secretary, who is chief examiner, and office employees.

Duties of Commission

United States and Oakland—To arrange in classes all offices, places, and employments to be filled by selections according to grade from among those standing highest in open competitive examinations; to hold examinations for testing the fitness of applicants and prepare classified eligible lists; to prepare rules governing civil service and to establish efficiency-ratings providing a minimum for promotion and also minimum ratings for demotion or dismissal.

California—Same as United States, but positions are to be graded so that like salaries shall be paid for like duties. Classes and grades may be changed, but persons holding positions under original classification shall not be affected.

San Francisco—Same as California, but without provisions for efficiency-ratings.

Los Angeles—Same as United States, but without provision for efficiency-ratings.

Exempted Positions

United States—All positions in Alaska which can not be filled from appropriate existing registers.

Consulting architect for work of reconstructing West Point Military Academy.

Superintendent of construction, Quartermaster Corps, Corregidor, P. I.

Consulting engineers of the Reclamation Service.

Officers and employees in the service of the Isthmian Canal Commission except draftsmen.

Inspecting engineer, purchasing department.

Members of the board of engineers, Division of Valuation, Interstate Commerce Commission.

All persons whose appointments are subject to confirmation by the Senate, and persons appointed by the President without confirmation by the Senate.

California—Employees of the State Railroad Commission.

Superintendents, chiefs and heads of departments.

San Francisco—City engineer.

City architect.

Persons employed by the Board of Supervisors for for temporary service in positions requiring high technical skill.

Persons employed on public work outside the city

Los Angeles—City engineer and chief deputy.

Assistant harbor engineer.

Chief engineer of waterworks.

Engineer of the Board of Public Utilities.

Inspector of public works.

Oakland—City engineer.

Superintendent of streets.

Building inspector.

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All employees who may be excepted upon the recommendation of the Council, approved by unanimous vote of the civil-service board.*

The various civil service laws and regulations may be summarized for comparison as follows:

Excepted Positions. The provisions of the civil service laws and regulations do not apply to heads of departments, and engineers possessing high technical skill and exceptional qualifications may be employed temporarily on special work.

Qualifications of Applicants. United States citizenship is required by all except Oakland, and actual residence is specified in all cases, which conditions may be waived in the cities, however, when positions requiring technical, scientific or professional knowledge are to be filled.

The age-limits vary, being prescribed or changed by the United States commission, the minimum at present for engineers being 20 years and the maximum when fixed, 45 years, though in many cases no maximum age-limit is mentioned. Applicants for positions in the service of the state and the cities must be at least 21 years of age and not over 60 years in California or 50 years in Los Angeles. No maximum age-limits are specified in San Francisco and Oakland.

Examinations. All examinations shall be open and competitive, of a practical character and shall relate to matters which will fairly test the relative capacity and fitness of the applicants, the subjects including experience, being weighed by the commissions. A minimum standing of 70% is required by the United States, California and Oakland, and of 75% by San Francisco and Los Angeles.

Eligible Registers. The names of all who successfully pass an examination are placed on the proper eligible-register in the order of their ratings. The term of eligibility is one year in the United States and California, and two years in San Francisco, Los Angeles and Oakland.

Certification. When certification of eligibles is requested, the commissions certify from the head of the appropriate register a number of names; in the cases of the United States, California and Oakland, this number is sufficient to permit the appointing power to consider three names for each vacancy, the first selection being made from the highest three, the second from the highest three remaining and additional selections in like manner. In San Francisco, only the highest name on the eligible register is certified. In Los Angeles, there is also a list of permanent employees, eligible for certification by reason of temporary lay-off or leave of absence, which takes precedence over the ordinary eligible list and from this list, in regular order, one name is certified for each vacancy. In certification from a list of eligibles, the number of names submitted varies from two for one vacancy to 28 for 21 vacancies.

Failure to Respond to Certification. This is not provided for in the United States rules, but the rules of California and the three cities permit the commissions to revoke the certification unless satisfactory reasons are presented for the failure to respond.

Declination and Waiver of Certification. Declination of appointment causes removal of the name from the eligible register. The United States permits restoration if circumstances beyond the applicant's control prevented acceptance, and if he will agree to accept the next appointment offered in the locality. In California the name may be restored at the discretion of the commission.

Waiver or suspension of certification is granted by the United States and California for a period specified by the applicant and for one year by San Francisco and Oakland.

Temporary Appointments. Temporary appointments can not be made without the consent and approval of the commission and then only when there is no eligible list. The periods for which such appointments may be made are 30 days in the United States service or longer with the approval of the commission, three months in California which may be extended for three months more by consent of the commission and for a further period by commission's consent, 60 days in San Francisco and Los Angeles and 8 months in Oakland.

Permanent Appointments. After appointment there is a probationary term of six months in the United States service, California, San Francisco and Los Angeles and one year in Oakland. Unless the appointee shall have been dismissed within this period for reasons stated in writing, his appointment becomes permanent.

Method of Making Appointments. Upon request of the appointing officer the commission certifies from the head of the appropriate register a number of names from which, beginning with the highest, the appointing officer selects one eligible for each vacancy and makes the appointment. The number certified in the United States service, California and Oakland must be sufficient to permit the appointing power to consider three names for each vacancy; in San Francisco only the highest is certified and in Los Angeles the number varies from two for one vacancy to 28 for 21 vacancies. There is a provision in the California law that no person shall be appointed under any title not appropriate to the duties to be performed and that no person shall be assigned to perform the duties of any other position than that which he legally holds except by consent of the commission.

Efficiency Records. Provision is made for efficiency ratings in the United States service, in California and in Oakland, none being prescribed in San Francisco and Los Angeles. If an employee of the United States falls below a certain minimum, he is demoted or dismissed. The California and Oakland ratings are based on quality and quantity of work, discipline, sobriety, obedience to rules, personal neatness and attendance.

*The complete report contains detailed information regarding the various aspects of the civil-service regulations of the different governmental bodies, and this information is then summarized. Only the summary is printed here.

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Thoroughly satisfactory work is rated at 85% and a marking below 70% for any month renders the employee liable to trial upon a charge of inefficiency with the penalty of removal if the charge is found just.

Promotion. Promotion, as far as possible, is based upon merit determined by competitive examination, consideration being also given in California to superior qualifications as shown by efficiency records, and in Los Angeles and Oakland to seniority.

Reinstatements and Transfers. The United States, California, Los Angeles and Oakland permit reinstatement within one year of an employee separated without misconduct from a competitive position; San Francisco has no provision for reinstatement.

The United States, California, Los Angeles and Oakland prohibit transfers to positions requiring higher qualifications except after passing an examination, the United States requiring in addition three year's service in the department from which transfer is made.

Tenure of Position. No employee can be removed except for such cause as will promote the efficiency of the service and for reasons given in writing.

Suspensions, Trials and Dismissals. Suspensions for cause may be made by the appointing power for reasons given in writing, the maximum period of suspension being 90 days in the United States and 30 days in California, San Francisco and Oakland, no maximum period being fixed in Los Angeles. The privilege to file a written answer is permitted in California.

No employee can be removed except for cause and for reasons given in writing, a copy of which must be furnished the accused and a reasonable time allowed for answering the charges. In the United States service, a trial is held only when considered necessary by the removing officer and the commission has no power to review the findings of a removing officer unless the required procedure has not been followed. In California, the charges are tried either by the appointing power or by the commission and a judgment or removal by either is final. In San Francisco and Los Angeles, an appeal from the findings of the appointing power to the commission is permitted, while in Oakland all charges must be tried by the commission.

Resignations. Los Angeles and Oakland have no rules regarding resignations. The United States requires sufficient notice to prevent embarrassment of the service, and California and San Francisco permit reinstatement with the consent of the commission, within one year.

Reduction in Force. In California and Oakland, when a reduction of force is necessary, employees are laid off according to their efficiency records, in San Francisco and Los Angeles according to seniority. California rules provide for placing the names of employees laid off on the lay-off list with certification when requested, in advance of other eligibles. In San Francisco and Los Angeles, the names are placed on the eligible register.

Leave of Absence and Vacations. Heads of departments in the United States service may grant 30 days' annual leave, dependent upon good conduct or faithful service and in addition, 30 days' sick leave in any one calendar year in exceptional or meritorious cases. California grants 15 working days each year to all employees in service for at least six months and San Francisco 12 working days for employees of at least one year's standing. There are no rules regarding vacations in Los Angeles and Oakland. There are special provisions for sick leave in California and Oakland, with pay for various periods depending on length of service. Leave of absence may be granted for one year, with reinstatement at the expiration of the leave. Absence without leave is cause for dismissal in California and Oakland and failure to report for duty at the expiration of a leave of absence is deemed a resignation in Canifornia, San Francisco and Los Angeles.

Prohibited Activities. The United States prohibits soliciting or receiving political assessments from any officer or employee, making political contributions to officers or employees, receiving gifts from inferiors or making them to a superior, interfering with elections or taking part in political campaigns. California prohibits solociting and receiving political contributions or influencing votes by promises of appointment, and San Francisco, Los Angeles, and Oakland prohibit taking an active part in politics.

Payment of Salaries. California, San Francisco, Los Angeles and Oakland require that all pay rolls must be certified by the commission.

Classification. The United States Civil Service Commission prepares and furnishes registers for certification to civil engineering positions in thirteen principal services, but does not publish these registers. In addition to the regular examinations which are held with more or less frequency, the commission is often called upon to hold special examinations for positions of a technical or scientific character when eligibles are needed and in these examinations competitors are rated entirely on education and preliminary experience with a weight of 40% and responsible experience with a weight of 60%. A complete schedule of salaries for the various positions could not be obtained, but the following will give some idea of salaries paid in different services:

Senior drainage engineer, Department of Agriculture, minimum $3000.

Assistant engineer, Engineer Department, minimum, $2000; maximum, $3000.

Surveyor, Engineer Department, minimum, $1080; maximum, $1800.

Senior civil engineer, Division of Valuation, minimum, $2700.

Senior structural engineer, Division of Valuation, maximum, $2700.

Engineer of tests, Office of Public Roads, minimum $3250.

Civil engineer, Philippine Service, minimum $3000.

Assistant engineer, Reclamation Service, minimum, $1500.

Junior engineer, Reclamation Service, minimum $900.

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Computer and estimator, Architect's Office, minimum, $1600.

Structural engineer, Architect's Office, minimum, $1600.

California has classified positions in the civil engineering service in five grades with five sub-classes, as follows:

Engineering assistants, salary range $40 to $150 monthly.

Civil engineers, salary range $40 to $300 and above monthly.

Engineering draftsmen, salary range $40 to $200 monthly.

Structural engineers, salary range, $150 to $300 monthly.

Structural draftsmen, salary range, $100 to $200 monthly.

Positions in the inspection-service are classified in three grades with three sub-classes, as follows:

Inspectors of general construction, salary range $75 to $200 monthly.

Inspectors of building construction, salary range $75 to $200 monthly.

Inspectors of road construction, salary range $75 to $200 monthly.

The supervising service has one sub-class, namely:

General foreman and superintendent of construction, salary range, $100 to $200 monthly.

San Francisco has classified positions in the civil engineering service as follows:

Supervising engineers, salary range $125 to $350 monthly.

Civil engineers, including assistant engineers, salary range $150 to $200 monthly.

Surveyors, salary range $165 to $250 monthly.

Engineering draftsmen, salary range $100 to $200 monthly.

Cartographers, $150 monthly.

Surveyor's field assistants, salary range $135 to $175 monthly.

Civil engineering positions in the architectural service are classified as follows:

Structural engineers, no appointees.

Consulting structural engineer, salary range $200 and over monthly.

Los Angeles classifies all engineering positions under the general heading of Engineering Service, but no information could be obtained concerning classes or salaries.

Oakland classifies positions in the civil engineering service in six grades as follows:

Assistant draftsman, salary range $60 to $70 monthly.

Chainman, salary range $75 to $90 monthly.

Draftsman, hydrographer, instrumentman, salary range $110 to $125 monthly.

Junior engineer, office engineer, field engineer, testing engineer, office engineer harbor department, salary range $135 to $160 monthly.

Assistant engineer, architectural engineer, assistant harbor engineer, $165 to $200 monthly.

Deputy city engineer and assistant superintendent of streets, salary range $250 and above monthly.

The civil engineering positions in the supervising service are graded as follows:

Deputy superintendent of streets, $200 monthly.

Assistant deputy superintendent of streets, $175 monthly.

Assistant superintendent of construction, $160 monthly.

Although the laws governing civil service were placed on the statute books for the purpose of eradicating the evils of political patronage and while there is no doubt that most, if not all of the commissions entrusted with the enforcement of the law are sincerely endeavoring to carry out its intent, it is apparent that in many cases the law has failed of its purpose. This is the result in part to inherent defects, in part to causes which lie deeper. It is questionable whether the method of basing appointments on the results of competitive examinations produces the best material as far as engineering work is concerned, and it is undeniable that engineers in the public service who are familiar with the workings of the examination system are not enthusiastic over it. That the Federal Commission, to a certain extent, realizes the shortcomings of the system is evidenced by the fact that at the present time all appointments to positions of responsibility requiring a high order of ability and technical knowledge are based on training and experience, and that the California Commission also believes that other qualifications are necessary besides the ability to solve problems is shown by their requiring applicants to appear before them for a personality test.

The minor defects in the laws can and will be remedied in time, but the danger of political interference will remain as long as officials, either elected or appointed by some political party, are allowed to defeat the purpose of the laws by evasion or by disregard of their provisions. It is true that the present civil-service system is a decided improvement on the old one in which appointments were based entirely on political affiliations, but its full benefits will not be obtained until the people realize that they themselves are responsible for failure to enforce its provisions.

The committee has not attempted to investigate methods and conditions of employment by State and municipal governments, being of the opinion that any body undertaking such an investigation should be clothed with judicial powers and that without such authority the data obtained would necessarily be one-sided, unreliable and valueless.

JEROME NEWMAN, Chairman,
L. S. GRISWOLD,
S. G. HINDES,
FRANKLIN RIFFLE,
R. A. THOMPSON.

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Repair of Bituminous Pavements*

The repairs necessary on asphalt pavements may be placed in a general way in two classes. One class includes surfaces that have become irregular from wear or from minor movements of the material in the wearing-surface. The other class includes breaks, cracks, areas in which rolls or 'shoves' have taken place affecting the whole asphalt surface, and depressions caused by settlement of the foundation.

If irregularities of the first class can be corrected without taking up the whole pavement, material is saved and probably, also, labor and time. The obvious way of doing this is to heat the asphalt surface until it is soft enough to be raked, supplied with the necessary amount of new material to fill any depressions, smoothed and rolled into place. The Perkins heater was invented early in the history of asphalt pavements to perform this service. It consists of a series of gasoline-burners under a hood which directs the hot flame and gases of combustion against the asphalt surface. When carefully operated, this machine does good work. The flame sets the surface-asphalt on fire and burns it. If the flame is made hot quickly, the asphalt below does not absorb the necessary heat before the surface is burned. Experience with the operation of the machine and expertness in determining from observation when the asphalt is properly heated and how much of it must be raked off to be sure to reach the uninjured mixture below are essential to good work with the machine. More pavement than is repaired may be injured by putting the operation of the machine in the hands of a foreman with poor judgment and little or no experience. This accounts for the prejudice against the direct-heat process that exists in some places.

Several attempts have been made to devise a machine which would discharge hot air and combustion-gases against the surface of the asphalt, thus heating the asphalt without burning it. This requires a larger machine because large quantities of air must be heated and discharged under some pressure against the asphalt surface. The Lutz asphalt-repair plant works in this way and is doing satisfactory work at a low cost, not only for this class of repairs but for those of the second class described later. A portable plant for supplying the mixtures, having one drum, or having two drums so that both binder and surface mixtures can be prepared at the same time, is supplied either to accompany the surface-heater, or to operate alone. The Hooke asphalt-repair plant is a small asphalt-kettle plant of special design used in a number of cities. The manufacturers of asphalt-paving machinery also supply such plants for small repairs.

In repairing defects of the second class it is economical to go as far as may be necessary to reach the seat of the trouble. If the defect is the result of settlement of the foundation, cut entirely through the concrete and remove enough material to determine whether additional settlement is possible. Compact the sub-grade thoroughly by flushing or tamping, and put in new material which will compact well to take the place of any unsatisfactory material removed. Use concrete for filling if the cavity is not too large. If the settlement is in an old trench or excavation, carry the cut along its length far enough to reach well solidified material, then widen the cut in the concrete so that the new concrete, when placed, will bridge the trench and form a sort of arch over it, being supported by and against the solid ground on each side of the trench. Place the new concrete and tamp it well into place, leaving the top-surface even with the surface of the old concrete around the edges of the excavation and uniform so that the asphalt top will be of uniform thickness.

After the concrete has set and is ready to receive the wearing-surface, and also if it has not been necessary to cut into the concrete, sweep out the opening thoroughly and clean the edges of the asphalt, cutting them so that the sides of the opening will be vertical. Cut back until the edge shows good material and the top shows that there is good material behind it. The cuts should be rectangular, not rounded, and the sides fairly straight. A sharp instrument which will not shatter the adjoining surface is necessary. It is quite common to cut the edges sloping, but this leaves a feather-edge of the new material which may make an outline of the patch, whereas if the edges are cut vertical and the patching is well done, the patch can hardly be distinguished from the original surface after a few days. Paint the edges of the cut with asphalt-cement so that the old surface is covered thick enough to cement the old and new together but not thick enough to make an appreciable joint between the two.

The opening should then be filled, first with the cushion-coat, well tamped into place, and then covered with enough surface-mixture so that when rolled thoroughly the patch will have a surface uniform with the old surface surrounding it; neither depressed so as to be pounded by heavy traffic nor elevated so that the traffic will pound the old pavement on the sides of the patch and thus form new holes.

To produce the best results, the mixture used in the old pavement should be ascertained and the new mixture should be the same, except that the old pavement will probably be harder than when first laid and therefore somewhat stiffer asphalt-cement should be used so as to make the hardness of the new mixture when compressed conform with that of the old pavement.

*Abstract from 'Municipal Engineering'.

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No repair work should be done in wet weather or in weather so cold that the old surfaces of heater-patches will get cold before the new material is applied or so that the new material will get cold before it can be thoroughly rolled.

When a city has laid pavements for many years under different specifications and with different materials used by different contractors and at different times, it will not be possible to vary the mixtures sent from a central plant to suit the variations in conditions encountered in a single day's work, or even in the work covered by a single load. For this reason a good portable plant can sometimes do better work on account of the possibility of varying the mixture in each batch, to suit conditions.

Again, old pavements may be so worn that it will be better to use two layers than one. Too frequently, surface-mixture only is used in patching. This is frequently the reason why the next patching of the street is largely the replacing of the previous patches with enlargements on account of the deterioration of the old pavement adjoining them.

Cracks are sometimes patched by filling with a fine soft mixture instead of by cutting and replacing completely. This practice is likely to result in a larger and wider patch the next time.

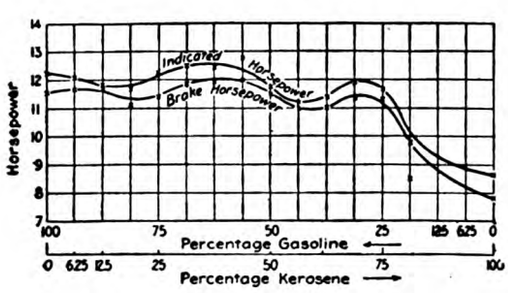
While the ideal conditions of repair work are seldom attainable, an expert foreman can and will approximate them closely by varying his treatment and thus make patches of fairly long life, if they are not equal to the original pavement. Sometimes foremen pride themselves on making patches that are better than the original pavement. While this is better than patches much poorer than the original, the former kind of patch is likely to increase the rate of deterioration in the old pavement and thus shorten the period until the next patching. When a pavement is old and patches are large, an entirely new surface is thus obtained in the course of two or three years at the expense of the repair-fund and to the benefit of the construction-fund or of the property-owners who would pay for a new pavement. The result is a pavement more irregular and less durable than a new pavement and more or less economical according to the relative costs of patching and of new surfacing.

Searchlights have recently been improved by the use of various methods of cooling the electrode with a view to obtaining greater local concentration of the light. This is done either by a spray of alcohol, or, gas in the Sperry searchlight, by a blast of air. Another line of development being investigated in Germany has been the use of arcs under high atmospheric pressure. Lummer was reported to have obtained promising results shortly after the outbreak of war, and it was thought possible that a considerable improvement in the efficiency of arc-lamps and projectors might be secured in this way. According to some recent experiments in Germany, this anticipation is not being realized. Pressures up to five atmospheres were employed with both inclined and vertical carbons. In the former case a marked gain in efficiency was secured, but the arc was found to be unstable for pressures exceeding one atmosphere. On the other hand, with vertical carbons, more stable conditions are realized, but the gain in efficiency seems to be moderate.

GASOLINE-KEROSENE MIXTURES FOR INTERNAL-COMBUSTION ENGINES

A series of tests to determine the relative power-output of a 15-hp. four-cycle gasoline-engine, when supplied with different mixtures of gasoline and kerosene, were recently made by Messrs. McGinnis, Hutchinson, and Udy for a graduating thesis at the Virginia Polytechnic Institute.

The engine was first started on gasoline and allowed to run until it became thoroughly warm, then was quickly switched over to the mixture of gasoline and kerosene. As will be seen from the curves, the horsepower output gradually increased as the proportion of kerosene was increased, up to about 50%, at which point it began to diminish rapidly. At about 60% of



CURVES OF POWER-OUTPUT

kerosene the engine began to pound. This pounding became more and more marked as the proportion of kerosene increased, until at about 90% it became necessary to retard the spark with consequent reduced pounding, but also a decrease in power.

Although the exhaust was led to a sewer, there was a noticeable odor from the burning of the kerosene when the proportion reached about 40%. This odor became more obnoxious as the mixture grew stronger in kerosene. At about 80% the air in the room had a blue appearance, because of the presence of the partly burned products that had leaked from the flanges of the exhaust-pipe and escaped past the piston.—*Power.*

Paper belting as well as paper cordage is now being used in the Fiume, Austria, district. The belting is matlike and is woven with the ordinary paper cord, and may be strengthened by various processes. It does not have the strength of leather belting and the abrasion on the paper cord makes the life of the belt comparatively short.—*Scientific American.*

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Filtration Systems in North American Cities

The following table prepared by Burns & McDonnell, consulting engineers of Kansas City, Missouri, and re-printed from 'The American City', gives a summary of data regarding water-filtration systems in American and Canadian cities in 1917. The growing use of filtration is illustrated by the fact that in 1900 there were only 50 cities with a population of less than 2,000,000 using filtered water. The death-rate from typhoid fever has decreased at about the same rate as the use of filtered water has increased. It will be noted that nearly one-fifth of the total population of the United States and Canada, and about one-half of the urban population is supplied with filtered water at the present time.

STATE.	Municipal Owned.	Private Owned.	U. S. Owned	Total Plants.	Population Covered.	Total Filter Capacity.
Alabama	6	5	..	11	250,000	27,025,000
Arizona	..	1	..	1	3,000	300,000
Arkansas	3	6	..	9	103,000	14,100,000
California	5	12	1	18	1,168,000	96,463,000
District of Columbia	1	..	..	1	353,000	75,000,000
Colorado	6	3	..	9	271,000	62,475,000
Connecticut	3	3	..	6	175,000	31,000,000
Delaware	1	..	..	1	92,000	24,000,000
Florida	1	..	..	1	3,000	.....
Georgia	26	2	..	28	345,000	64,350,000
Iowa	11	10	..	21	276,000	53,700,000
Indiana	5	14	..	19	553,000	92,950,000
Illinois	15	21	2	38	481,000	112,050,000
Kansas	29	4	1	34	218,000	42,726,000
Kentucky	7	11	..	18	379,000	108,750,000
Louisiana	3	1	..	4	406,000	52,500,000
Maine	2	8	..	10	86,000	22,550,000
Maryland	5	5	..	10	631,000	141,850,000
Massachusetts	10	2	..	12	368,000	44,800,000
Michigan	4	5	..	9	235,000	54,410,000
Minnesota	8	3	..	11	380,000	62,928,000
Missouri	16	15	..	31	1,021,000	203,432,400.
Mississippi	4	1	..	5	83,000	14,300,000
Montana	6	..	..	6	35,000	22,800,000
New Jersey	13	19	..	32	339,000	165,194,000
New York	41	20	2	63	2,859,000	198,194,000
Nebraska	1	1	..	2	6,000	600,000
New Hampshire	2	4	..	6	51,000	6,614,000
New Mexico	2	1	..	3	6,000	1,500,000
North Dakota	6	..	..	6	42,000	8,836,000
North Carolina	32	7	1	40	315,000	47,455,000
Ohio	40	10	..	50	2,025,000	510,055,000
Oklahoma	28	..	..	28	266,000	45,720,000
Oregon	5	5	..	10	33,000	12,618,000
Pennsylvania	19	80	..	99	3,436,000	860,361,000
Rhode Island	1	9	..	10	316,000	33,000,000
South Carolina	9	6	..	15	172,000	27,400,000
South Dakota	1	2	..	3	24,000	1,850,000
Tennessee	5	3	..	8	125,000	23,500,000
Texas	16	3	..	19	378,000	42,130,000
Vermont	1	2	..	3	30,000	4,570,000
Virginia	7	6	1	14	205,000	29,150,000
Washington	2	..	..	2	8,000	1,500,000
West Virginia	7	6	..	13	122,000	25,000,000
Wisconsin	6	5	..	11	176,000	38,950,000
Wyoming	3	1	..	4	12,000	6,115,000
Alberta, Canada	3	..	..	3	62,000	12,000,000
Manitoba, Canada	1	2	..	3	16,000	4,350,000
New Brunswick	1	..	..	1	7,000	2,000,000
Saskatchewan	4	..	..	4	40,000	10,400,000
Quebec	10	7	..	17	539,000	166,250,000
Totals	443	330	8	781	19,545,000	3,650,771,000

CREOSOTED WOOD-STAVE PIPE AND ITS EFFECT UPON WATER FOR DOMESTIC AND IRRIGATION USES

While untreated wood-stave pipe has a long life when conditions are favorable, decay is likely to be rapid in cases where the pipe is empty for considerable periods. Creosoted wood-staves, on the other hand, have a long life under such conditions, and also in some soils where untreated staves are likely to decay.

To determine whether creosoted pipe has any deleterious effect upon the water that passes through it, the Bureau of Industrial Research of the University of Washington made a series of experiments, using pipe made of Douglas fir staves that had been treated with 16 lb. of creosote to the cubic foot. Water was circulated through the pipe for 6 hours before taking each sample and tested for taste and also for its effect upon plant-growth when used for irrigation. The conclusions of the Bureau, as given in Bulletin No. 1, are as follows:

1. After the experimental pipe-line had been in service for 13 days, no taste of creosote could be detected in a sample of the water diluted with two parts of ordinary city water.

2. After the experimental pipe-line had been in service for 29 days, no taste of creosote could be detected in undiluted water flowing through it.

3. The amount of creosote that diffuses into water in ordinary creosoted pipes does not have an appreciable injurious effect upon plants either in the time of germination, the proportion of germination, the rapidity of growth, or the general vigor of the plant.

Casinghead gasoline was being produced in California in June 1917 from 43 plants, having a total daily production of 1753 bbl. Of this number, 28 plants with a production of 1040 bbl. per day, used the compression process, and 3 plants with a production of 43 bbl. per day used the absorption process, while the remaining 12 plants, with a production of 660 bbl. per day, used both processes.

Cost of street-sprinkling in Los Angeles was $1.09 per mile of street sprinkled when teams were used, and $0.86 per mile with motor trucks.

Iron ore mined in the United States during 1916 amounted to 75,167,672 gross tons, the greatest annual output ever recorded.

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Methods and Cost of Reforestation

The U. S. Department of Agriculture has recently published Bulletin No. 475 on 'Reforestation on the National Forests,' by C. R. Tillotson, describing this branch of the work of the Forest Service. This work is done both by seeding and by planting young trees.

Seed may be sown broadcast, in strips or blocks, or by the 'seed-spot' method. In the latter method small spots spaced regularly are prepared for reception of the seed by loosening with some tool. The number of seed planted on each spot depends on the probable percentage of germination, with the assumption that from 10 to 12 seeds should germinate. Experiments have shown the percentage of germination to range from 22% for Arizona cypress to 89% for Norway pine. These figures are for greenhouse conditions, and would be reduced somewhat for field work. The amount of seed required for broadcast sowing ranges from 1½ to 2½ lb. per acre for western red cedar up to 10 to 20 lb. for sugar pine. For seed-spot sowing the amount ranges from ⅜ lb. per acre for western red cedar to 3 lb. for sugar pine. The Forest Service has adopted a standard 'stocking' of 800 trees per acre, the number actually planted ranging from 600 to 1000 or more according to local conditions.

Records show actual costs of sowing ranging from $1.59 to $20.78 per acre. Cost of planting range from $3.36 to $19.10 per acre. It is stated that for most reforestation operations conducted on a large scale, the cost of direct seeding can be kept between $4 and $6 per acre and the cost of planting under $10 per acre.

Fire-guards should be constructed. On the Nebraska National Forest, these consist of two parallel strips of plowed ground each 12 furrows wide, separated by a strip of unplowed ground about 30 ft. wide. The cost of construction is about $0.50 per mile per furrow.

The following recommendations are made regarding the best methods of reforestation in the western States:

Arizona and New Mexico

Western yellow pine: Approximate altitudinal limits from 7000 to 8500 ft. The sites in the order of their favorableness for planting or sowing are:

1. Old cuttings on western yellow-pine land. Usually such areas are practically denuded of tree-growth and bear a dense growth of grass.
2. Brush-land showing evidences of having been at least partly forested with western yellow pine but now occupied by a moderately dense growth of brush, such as oak, mountain mahogany, and buck brush or cliff rose.
3. Untimbered parks or prairies within the range of the species.

Douglas fir: Approximate altitudinal limits from 8000 to 9000 feet. The sites in the order of their favorableness are:

1. Old burns with moderately dense new stands of aspen.
2. Old burns bare of aspen or other shrubs but strewn with down logs.
3. Open grass-lands.

Engelmann spruce: Approximate altitudinal limits from 9500 to 11,000 feet. The sites in the order of their favorableness are:

1. Spruce burns with new growth of aspen.
2. Spruce burns without new growth of aspen but strewn with down logs.

Utah and Southern Idaho

Western yellow pine in Utah: (1) Burned-over areas in the natural yellow-pine types; (2) areas covered with brush, mainly of oak, maple, and service berry; (3) areas covered with open stands of scrubby aspen; (4) sagebrush areas.

Western yellow pine in southern Idaho: (1) Those sites producing yellow pine naturally; (2) brush areas within the limits of yellow pine and adjoining stands of that species; (3) open grassy areas in the neighborhood of timber stands.

Douglas fir: (1) Burns within the fir type; (2) sites covered with aspen of moderate density; (3) burns in the Engelmann spruce type.

Engelmann spruce: (1) Burned-over, non-restocking Engelmann spruce and balsam-fir cuttings; (2) the denser and better stands of aspen occuring at high altitudes; (3) lodgepole-pine burns.

Lodgepole pine: (1) Lodgepole-pine burns which are non-restocking; (2) non-restocking Engelmann-spruce burns; (3) aspen-covered areas at higher altitudes. This species is not thought suitable for planting on brush areas nor on open grassy land where sheltering objects are missing.

California

Planting has not yet progressed far enough to warrant a thorough and final classification of the sites. It has been demonstrated, however, that sowing is a failure throughout the State and that planting cannot be undertaken with any degree of success in the foothill region of southern California. At higher elevations in southern California, within the timbered belt, western yellow and Jeffrey pine are being grown successfully on open land free from rodents. The typical planting-sites in this region, however, are covered with heavy brush frequented by rodents. So far the depredations of these animals have not been successfully

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controlled, and from present indications these depredations cannot be controlled at a reasonable cost.

The planting of western yellow pine in the brush-fields of northern California gives promise of success, and it is thought that white fir and incense cedar will also do well there. Climatic conditions during the growing-season are variable in this State and influence the degree of success in planting to a large extent. Rodents also cause heavy loss, but indications are that spring planting, use of large stock, and planting on an area immediately after it has been burned will minimize the rodent-danger. Shade is important, since it assists in preserving soil-moisture.

Western yellow pine has been most successfully used between 3500 and 5500 ft. elevation. The best success is attained under full brush-shade, and a classification of planting-sites may be made largely upon the basis of the shade-characteristics of the brush species. The most favorable brush types are as follows, arranged in the order of their value:

1. Manzanita and snow-brush type.
2. White-thorn and manzanita type.

These types are generally found at elevations over 4000 ft. The oak and open-brush types found at lower elevations are more difficult sites, where success can only be obtained in favorable years.

Washington and Oregon

Douglas fir. 1. Areas covered with a dense growth of herbaceous vegetation in which fern usually predominates, indicating good soil and moisture conditions, mostly on the west side of the Cascade mountains and in the Coast region at altitudes below 2500 ft.; in the Coast region of the Siskiyou mountains at elevations under 1500 ft. The north slopes are the best.

2. Slopes covered with a medium growth of herbaceous vegetation indicating fair soil and moisture conditions, second only to class 1, mostly on the west side of the Cascade mountains and in the Coast region below 3000 ft.; in the Coast region of the Siskiyou mountains between altitudes of 1500 and 5000 feet.

3. Sites between 3000 and 4500 ft. in altitude on east and west slopes of Cascade mountains. On these sites the soil may be thin and rocky, but the moisture conditions are usually good. Douglas fir should be planted in mixture with noble fir on the west side of the Cascades, and with western white pine or amabilis fir on the east side.

4. North slopes at moderate altitudes in the Blue Mountain region, typically cool and moist.

5. Areas below 3000 ft. on the west side of the Cascade mountains and in the Coast region with only a scant ground-cover, indicating a dry exposed situation.

6. Dense salal or brush-covered slopes in the Coast region indicating good soil and moisture conditions, but keen competition.

7. Brush-covered, northerly slopes in the eastern part of the Siskiyou mountains at elevations of from 1500 to 5000 ft. with soil and moisture conditions variable but usually fair, and cover of California black oak, Oregon grape, manzanita, ceanothus, and willow on the better sites, and tan oak, chinquapin, huckleberry, live oak, and ceanothus on the poorer sites. Douglas fir should be planted in mixture with western yellow and sugar pines.

Noble fir. 1. Sites between 2500 and 4500 ft. on the west side of the Cascade mountains, except in southern Oregon. On these sites the soil may be thin and rocky, but the moisture conditions are usually good. Noble fir should be planted in mixture with Douglas fir.

2. Sites above 4500 ft. on the west side of the Cascade mountains. On these sites the soil is usually thin and rocky, but the moisture conditions good. Noble fir should probably be planted in mixture with amabilis fir.

Western yellow pine. 1. Occasional north slopes at moderate altitudes in the Blue mountains, with good soil and moisture.

2. Light brushy south slopes in the eastern portion of the Siskiyou mountains with fairly good but rather warm and dry soil and a cover of tan oak, chinquapin, huckleberry, live oak, and ceanothus. Sugar pine may be planted with western yellow pine on the better soils.

3. South slopes at low altitudes in the Blue mountains, typically hot and dry.

Peat has long been employed as a domestic fuel. Its industrial use could be most efficiently brought about by gasifying it in gas-producers, as this procedure would render feasible the recovery of several valuable by-products. The combined nitrogen of the peat can be recovered economically in the form of ammonium sulphate. This valuable fertilizer, together with the peat-ash containing potash and phosphoric acid, could be restored to the land from which the peat has been taken. Peat-tar, another by-product, can be fractionally distilled into the following useful materials: refined pitch and tar, candle-wax, lubricating and burning oils, and powerful disinfectants, greatly exceeding carbolic acid in germicidal strength. The aqueous distillate from the producer contains methyl alcohol, acetone, pyridine bases, and crude acetic acid, all of which are capable of recovery and utilization. The economical utilization of peat in the generation of gaseous fuel, even without recovery of by-products, is today an accomplished fact. It can scarcely be doubted that, with efficient chemical control, a plant of sufficient capacity to deal rationally with the ammonia, tar, and other products of the destructive distillation of peat would lead to still greater economies in the employment of this important combustible.—Journal of the American Peat Society.

Electric furnaces constructed at Sheffield, England, since 1914 have a total capacity of 27,350 kw. About 100,000 tons of steel is produced annually.

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Method of Filing Drawings

By ALBERT G. WOLF

The several methods of filing drawings in engineering-offices may be classified as follows:

1. Horizontally and flat { (a) In drawers. (b) On trays.
2. In vertical filing-cases.
3. Rolled { (a) In drawers. (b) In open racks. (c) In pigeon-hole compartments. (d) In tin cylinders.
4. Bound, on arch bill-files or by wooden strips on a rack, like newspapers in a library.
5. On spring rollers.

The first of these methods, that of filing flat in drawers, is in common use; it is considered the best by some engineers and the worst by others. It has the advantages of keeping the drawings flat and clean, and the sheet desired can be easily found. Some of the disadvantages, such as the difficulty of getting a drawing out from under a pile of others, or back again, without damage, or having to remove all drawings above it, can be minimized by making the drawers fairly shallow, and by having two or three sizes of drawers for different sizes of drawings. Weights can be used, if found necessary, to keep the corners of maps from being caught when moving the drawers in and out. The one disadvantage that cannot be overcome is the large floor-space required. If the set of drawers, however, be only table high, the top will serve for desk-room, and a well-finished set of drawers is not an unsightly piece of furniture in the office.

The tray system has the advantage that as the trays are closer together, many more of them than drawers can be put in the same space, hence, fewer drawings will be placed on each tray, and a closer subdivision of titles is possible. The set of trays can be enclosed in a cabinet with hinged doors, making the whole as dust-proof as any book-case. The use of trays, of course, presupposes that the drawings are absolutely flat. Drawings that have been rolled can be placed in large envelopes or containers, like those supplied with vertical filing-cases. Fig. 1 shows in elevation the method of constructing a set of trays. The horizontal dimensions may be anything desired up to four feet without the trays sagging materially. Two or three sets of trays of different sizes for various sized maps may be used, as with drawers.

Vertical filing-cabinets have the great advantage of large capacity for the small floor-space required. They also keep the maps clean, and the large number of compartments makes closer classification possible. The disadvantages are such as to make the use of the vertical cabinet undesirable when floor-space for drawers or trays is available. Lifting the large pockets, containing many drawings, in and out of the case is an inconvenience in itself. The small maps slip down, losing themselves between the larger ones, making it difficult to find them. The pockets, if heavily laden, wear out rapidly. If the drawings are all bound together at the top, instead of using the pockets, much trouble is involved in removing one of these drawings from the set. These vertical cases are furnished in only relatively large sizes, so that for small drawings they are a decided disadvantage.

Rolled maps in drawers take up a great deal of room, unless several maps are rolled together, in which case it is difficult to find the sheet wanted. All rolled maps, of course, have the disadvantage that they are harder to handle than maps kept flat. Very large maps, however, can only be filed without folding when rolled. Open racks are of two forms: one, consisting of vertical strips on the walls, with pegs projecting upward at an angle a little less than a right angle (Fig. 2). This method is hardly suited to filing a large number of maps because of the wall-space required, difficulty of finding a map, and unsightliness. A use for this rack is found in closets and vaults, and especially to support such drawings as are filed in tin tubes. The second form of open rack consists of a rectangular skeleton frame, as shown in Fig. 3. The numerous cross-pieces furnish support for smaller drawings. The over-all dimensions may be anything desired. The pigeon-hole compartment method is a variation of the skeleton rack, with the disadvantage that short drawings get pushed back into the compartments and are difficult to get out. Both forms have the objections inherent to methods of filing rolled maps; they do not keep the maps clean, and are not adapted to filing a large number of maps, or drawings, without crowding or rolling many maps in the same roll. The skeleton form has the advantage that maps of any width (length of roll) can be filed without having an unduly large frame.

Filing rolled maps in tin cylinders is adapted to only a small number of maps, but is an excellent method of protecting (from dust, moisture, and other injury) tracings of large maps that are brought up-to-date periodically for the purpose of making prints. As only a few maps are filed in this manner, the cylinders are conveniently placed on the peg-rack shown in Fig. 2.

Method 4, that of binding the drawings together and suspending in some manner, is one more adapted to grouping prints that are constantly referred to in the

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office, rather than as a method of filing original drawings or tracings, as its use necessitates the removal of many drawings before the one desired can be extracted, and the drawings are not protected from dust, etc. Two methods of binding are suggested here: the first, using

The last method, that of using spring-rollers, can hardly be considered alone as a method of filing, but is an excellent way to protect a few large general maps, such as a contour or geological map of a State, claim-map of a district, etc., to which constant reference is made.

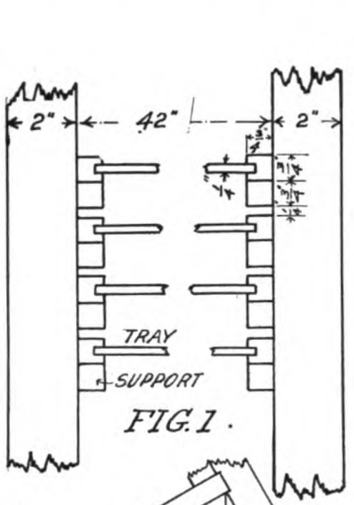

FIG. 1.

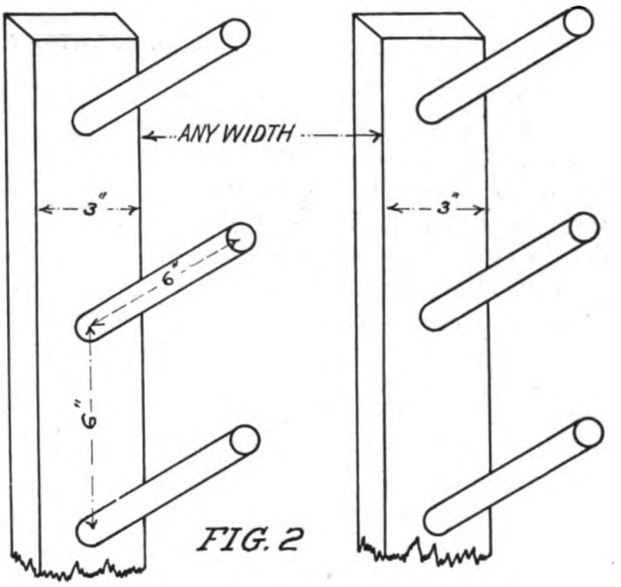

FIG. 2

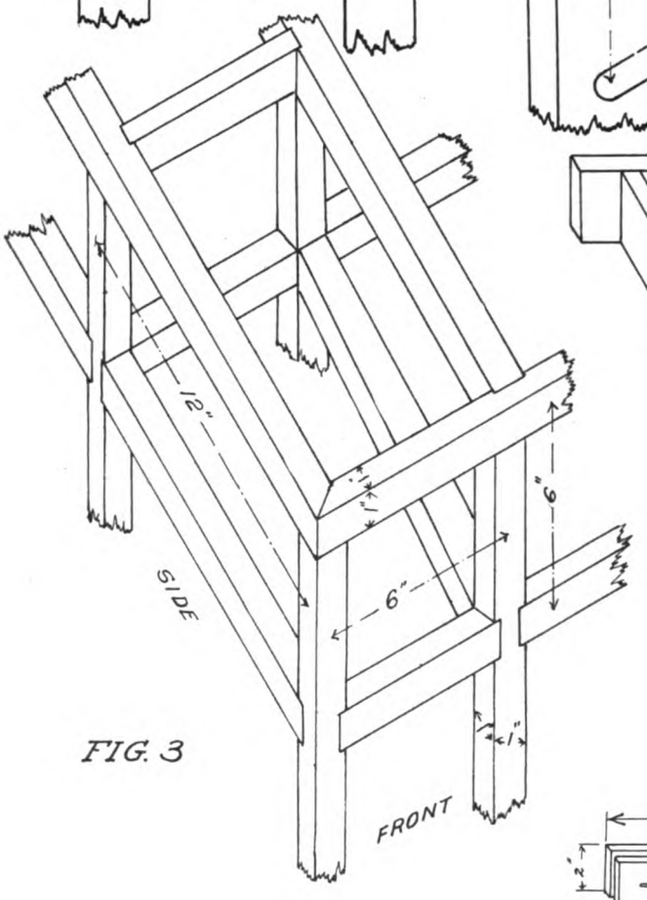

FIG. 3

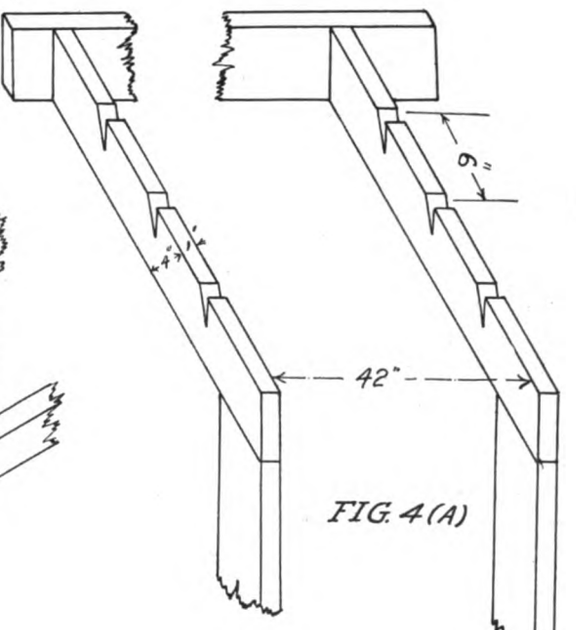

FIG. 4(A)

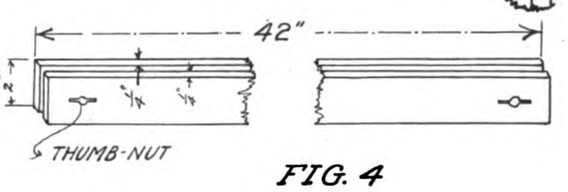

FIG. 4

the arch bill-file with a backing in proportion to the size of maps filed, and for large maps, two sets of arches on the backing instead of one; the second, by using two strips of wood, say, $\frac{1}{4}$ by 2 in., held tightly together by bolts and thumb-nuts (Fig. 4B). These groups of maps are then suspended by means of the binding strips on racks (Fig. 4A).

The maps are then as convenient for reference as the ordinary flat wall-maps, and less wall-space is consumed.

In most offices no one system of filing will suffice unless the number of drawings is very small. Wherever any one of the systems of flat filing is used, it must be supplemented by filing in rolls the larger tracings that must not be folded.

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The Use of Steel Conductors For Transmission Lines*

By H. B. DWIGHT

Although the tests to determine the electrical properties of steel wires and cables are incomplete, they nevertheless show some attractive possibilities from both commercial and engineering points of view for the use of steel instead of copper for certain classes of work. The resistance of an iron or steel conductor is considerably greater for alternating than for direct current.

Although high-grade steel wire has proved to be the best conductor for direct current, on account of its higher permeability to magnetism, it has a higher resistance to alternating current than a low-grade less expensive conductor. It is of interest to note that increasing the number of wires in a cable decreases the reactance, while increasing the size of the wires increases the reactance.

Another point demonstrated by tests is that a large part of the magnetization is caused by the spiraling of the wires in the cable. If the spiraling of the different groups of wires is reversed properly, the increase of effective resistance can be reduced as much as one-half. Thus, if the spiraling of one layer of wire is clockwise, the next should be counter-clockwise.

The effective resistance and reactance of a steel conductor increases as the current increases. This, however, continues only to a certain point, where the effective resistance begins to decrease again. In both cases, especially in large cables, the decrease is slow and the resistance is maintained approximately at its maximum value for large value of current. This property should prove useful in transmission-line work, for the conductor will have a low impedance to the normal load-current, but will have about twice as much impedance to the current flowing in case of a short-circuit. The impedance will also be large in high-frequency surges, caused by switching or lightning. It may prove more economical in certain cases to protect a line against short-circuits and surges by using steel conductors than by installing current-limiting reactors or by increasing the reactance of the transformers.

This property may also be used in the case of feeders of direct-current interurban railways. If the feeder be a steel cable, it will have low resistance to direct current, but high resistance to alternating current. It will, therefore, tend to reduce the suddenness of short-circuits and lightning surges, which cause synchronous machines to 'flash over.'

If the feeders are made of steel, and especially if the stranding be coarse, the required protection will be still more complete. Steel conductors would probably be economical only where it is allowable to use bare cable, as the increased amount of insulating-covering required for large-sized steel cables, compared with copper ones of the same conductivity, would greatly increase the cost of the former.

The higher conductivity of steel for direct current than for alternating current makes the use of bare-steel cables for direct-current feeders more economical than for alternating current. A steel cable has about eight times as much resistance to direct current as a copper cable of the same size and seven times as much resistance as a copper cable of the same weight, since copper is heavier than steel. Galvanized steel cable usually costs less than one-seventh as much per pound as copper cables, and so should be more economical, other things being equal.

Besides being cheaper than a copper cable for small branch lines, the steel cable has the advantage of being mechanically stronger and less liable to be burned through by arcs. The steel is, therefore, more reliable during wind-storms and at times of electrical breakdowns or trouble. The useful life of steel cables is shorter than that of copper cables, especially near the seashore.

From the data available it seems probable, considering a heavy transmission line complete with towers and insulators where an extra weight of steel conductor would be troublesome, that the cost will be approximately the same for either steel or copper. However, there are many cases where extra strength and size of steel cables are advantageous. The chief attention should be given to the classes of work where steel can show other advantages than merely low cost on a basis of carrying capacity for alternating-current power.

*Abstract of a paper read before the annual convention of the Association of Iron and Steel Electrical Engineers in joint session with the American Institute of Electrical Engineers, at Chicago, Illinois.

Leakage through concrete may be stopped by cleaning the walls thoroughly and painting with a solution consisting of 8 lb. of zinc sulphate dissolved in a gallon of water. The zinc sulphate will act on the lime in the cement, forming insoluble calcium sulphate and zinc hydroxide, and filling the pores in the concrete. Another method is to use one part water-glass (sodium silicate) to five parts of water, and apply a coat with a brush. Let it dry about 6 hours and apply another coat. Repeat until four coats have been applied, not allowing over 20 hours between coats.

Bituminous coal produced in the United States in 1916 amounted to 502,519,682 net tons, against 442,624,426 tons in 1915. Anthracite produced was 87,578,493 tons, against 88,995,061 tons in 1915.

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Methods of Wrecking Concrete and Reinforced Concrete Buildings*

Breaking up Mass Concrete. For the destruction of heavy bridge-piers, retaining walls, and foundation of mass-concrete, explosives have been used, both heavy charges which with one shot destroy the object, and the slower, but in many ways more convenient, light charges.

The heavy charge will destroy the entire surrounding masonry; however, this method usually separates the structure into large blocks which must be broken by the use of small charges. The light explosions are materially aided in their work since the first explosion opens the joints in the concrete. Internal cracks also aid in weakening the cohesion.

If small charges of explosives are used entirely, holes are drilled in the same manner as for blasting stone, and fired when the men are not working. In general it can be said that the breaking of rich gravel-concrete will require deeper holes and heavier charges than lean concrete in which crushed limestone was used. For the latter black powder is generally strong enough. Exact rules cannot be given, each case requiring individual treatment.

The chemical destruction of concrete is not practical. There is no practical available solvent for the strong silicic-acid substances released by the cement. Even if such a solvent were available the density of the concrete would prevent the desired action from taking place.

Wrecking Reinforced-Concrete Structures. Breaking up thin slabs of beam-and-slab floors is easily accomplished. On account of their hardness they cannot be readily worked with hand-chisels or even with compressed-air chisels or drills, but on account of their brittleness they can readily be broken into small pieces by letting heavy weights fall for a short distance upon them. Whether this is to be accomplished by a freely-falling heavy ram, such as was used in wrecking the building of the Baltimore News Publishing Company, or by the use of hand-sledges, as in the wrecking of a coal-washer at Stockholm, is mainly a matter of judgment of the structural engineer. In general a sledge-hammer will suffice for thin slabs, but for thick slabs a heavy ram handled by several men will be found more satisfactory and economical. The span between supporting beams is an important factor as for long spans the desired results can be obtained by comparatively light blows.

This method of breaking up slabs is limited to those with a thickness up to 6 or 6½ in., although for long spans somewhat thicker slabs can be broken in this way. Thick slabs should be treated like beams.

Beams should be cut from 12 to 16 in. from the support, so that the workmen will not be endangered by the fall of the middle part. The ends of the beams remaining on the columns can be removed when the columns are torn down. Cutting the beams can be accomplished by splitting the concrete with a hand-chisel or an air-hammer. This latter tool is especially well adapted since by the use of long thin chisels, cuts 1 in. wide can be made for the entire depth of the beam, and also because the amount of work is greatly diminished as compared with that required with the use of hand-chisels. The reinforcing-bars can also be cut by blow-flames, which are essentially more rapid and economical than steel saws. The use of steel saws, however, is not to be overlooked in small work where the installation of a blow-flame is too costly or in cases where large and heavy apparatus cannot be used.

The middle part of the beam after being cut from the supports will fall to the floor below. With this method of wrecking the vertical fall and the violent shaking of the piece of beam break the concrete and loosen the steel bars. What is more, it breaks the lower floor and thereby aids considerably in its destruction.

After all the beams and slabs have been broken, the columns with the stub-ends of the beams still in place can be overturned. This can be done by cutting away one side at the foot of the columns, as is done in the wrecking of high chimneys, the direction of the fall being readily governed in this manner. Here also the shattering effect of the fall is as effectual on the floor which breaks the fall as on the column itself. Special care and preparation are unnecessary, since the mass of a column 10 to 13 ft. long is not important. Two complete floors can often be wrecked and the columns then wrecked in two-story sections. In the lower stories where the columns are large and heavy, blasting can be used in place of cutting. In this case, the columns are attacked from one side by drilling deep holes and loading them with a light charge of explosive.

Reinforced-concrete walls should be first cut into sections from 6 to 9 ft. wide, then cut at the bottom and overturned with the aid of a rope or a heavy timber used as a ram. The shattering effect of the fall loosens the steel and breaks the concrete.

Destruction by free fall is often suitable. Where practicable try wrecking two or more stories at once by overturning complete parts of a building outward, inward, against, or upon one another. In heavy construction it is possible to destroy the entire structure at once by the sudden breaking of the basement-supports with explosives. This method of destruction is seldom feasible for buildings, but it can be used for wrecking bridges.

*Abstract of translation by Albert M. Wolf from 'Der Abbruch von Beton und Eisenbetonbauten', by Ernst Schick.

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In general the order of wrecking should be from top to bottom. The experience gained in the destruction of a concrete building in the Chicago stock-yards, however, shows that under certain conditions the reverse order of procedure is desirable.

Costs. Rules as to the cost of wrecking are not easily laid down. Based on the data regarding the wrecking of a coal-washer in Stockholm an average cost of $1.85 per cu. yd. is obtained. Assuming the cost of construction as $18.50 per cu. yd., the cost of wrecking amounts to 10% of the cost of construction. These costs are considerably reduced by the salvage. For ordinary dwelling and factory buildings considerably lower costs of wrecking can be assumed, about 92c. per cu. yd., or say 5% of the cost of construction. This is about the same as for brick-and-steel buildings.

TOPOGRAPHIC SURVEYS BY THE PANORAMIC CAMERA

Bulletin 657 of the U. S. Geological Survey on 'The Use of the Panoramic Camera in Topographic Surveying' by J. W. Bagley has been recently issued. The bulletin describes the general method used for this work, with particular regard to considerable work recently done in Alaska for the Survey under the direction of Mr. Bagley. There is also a discussion of the application of this method to surveys from a balloon or aeroplane for military and other purposes.

The camera has been used to a considerable extent for topographic surveying in Europe and also in Canada. In the United States, on the other hand, the plane-table has been used almost exclusively. This is probably largely because so much of the area that has been surveyed in the United States has been timbered or prairie country with but little relief. For such country the plane-table is undoubtedly the best instrument. There is, however, a large area in both the United States and Alaska that is sufficiently rugged and irregular to make it advisable to use both the plane-table and the panoramic camera.

The most striking feature of the panoramic camera as compared with the plane-table is that about one-fourth of the time required by the plane-table method at stations is needed with the camera. However, the rate of progress on many surveys is governed more by the speed of the pack-train than by the time required to occupy stations. If the average width of the country sketched with the plane-table is 15 miles and he makes 4 miles per day, he will probably occupy either one or two stations and sketch from 30 to 60 square miles from each station. In most mountains the average radius of work from a station will be the same for the camera as for the plane-table, for this limit is determined by the amount of detail necessary for the scale of the map, and the panoramic camera supplies photographs that have the necessary range. The final advantage from the use of the panoramic camera in surveys of this kind comes from an increase in the number of stations rather than from an increase of area surveyed per day, and the result of this increase in stations is an improvement in the map. The largest scale of surveys in which the panoramic camera has been used was 1: 48,000, but work could be done with sufficient accuracy for scales as large as 1: 20,000. The determining factor is usually the contour-interval, but the maximum error in elevation is probably not more than 25 ft. even in rough country.

The number of film cartridges used in the work will depend on the character of the survey and of the area to be covered. On an average for reconnaissance surveys on a scale of three miles to the inch three rolls of four exposures each will be needed for a day's work, on the basis of two stations and about 40 square miles of territory per day. For surveys on a scale of one mile to the inch in country having little timber, about one roll of film will be needed per square mile mapped. Greater proportions of timber will lower the number of rolls required, since more of the work will have to be done by traverses.

In Alaska about 500 square miles has been mapped on a scale of 1: 48,000 and 22,000 square miles on a scale of 1: 180,000. The contour-interval for the larger scale was usually 50 ft. and for the smaller, 200 ft. The horizontal control has been obtained from base-line surveys and triangulation, but the work has had to be done in advance of the establishment of exact geodetic control. Latitude has been obtained by transit observations of the sun or a fixed star, and longitude from various stations that have telegraphic communication with some established position. Where vertical control could not be started from some known datum or from sea-level, a datum was established with either an aneroid or mercurial barometer. The control was carried along by vertical angles. Several areas were surveyed by the use of the panoramic camera aboard ship.

Cost of street cleaning in Philadelphia is given in the annual report of the Bureau of Highways. Using machine-brooms, the cost per 1000 sq. yd. was 24.6c. for granite blocks, 19.3c. for brick, 16.6c. for wood block, 15.6c. for sheet asphalt, or an average of 22.6c. for all classes of pavement. Costs for other methods of cleaning are not segregated, but the averages are as follows: squegee, 14.8c. per 1000 sq. yd., and flushing, 15.7c. The squeegees were used on sheet-asphalt and wood-block pavements only.

Vertical curves at changes of highway grade are recommended by H. E. Bilger, State highway engineer of Illinois. Such curves should be arranged so that there is a clear view ahead of 300 ft. at any point, so as to prevent collisions. At railroad crossings the roadway should be at least 18 ft. wide to avoid the chance of stalling an automobile engine at the crossing when reducing speed to pass another car.

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Engineers' Note Book

MUNICIPAL WATER SYSTEMS IN CALIFORNIA

The accompanying table is taken from a report on a water-supply for the city of Sacramento, by C. G. Hyde, G. H. Wilhelm, and Frank C. Miller. Under ownership, *M* stands for a municipally-owned and *P* for a privately-owned system.

Number	Name of Community	Estimated Population	Number of Services	Number of Meters	Per Cent of Services Metered	Average Daily Water Consumption			Ownership of Works	Range of Pressure, Lbs. per Sq. Inch	
						Total	Per Service	Per Capita		Ordinary	Fire
1.	Corcoran	750	152	.....	...	150,000	987	200	P	30- 50	30- 50
2.	Dutch Flat	250	50	.....	...	20,000	400	80	P	25- 75	25- 75
3.	Escalon	200	125	.....	...	45,000	360	225	P	70	70
4.	Folsom	1,250	210	.....	...	300,000	1429	240	P	20- 55	20- 55
5.	Guadalupe	500	100	.....	...	20,000	200	40	P	19- 28	19- 28
6.	Kennett	1,400	225	.....	...	125,000	556	89	P	40- 90	40- 90
7.	King City	750	168	.....	...	157,000	934	209	P	40- 60	90-125
8.	Loyalton	1,200	75	.....	...	55,000	730	46	P	30- 45	60- 80
9.	Madera	3,020	490	.....	...	500,000	1020	165	M	40- 57	80-110
10.	Merced	3,600	750	.....	...	600,000	800	167	P	40	.....
11.	Nevada City	3,000	800	.....	...	1,080,000	1350	360	M	25-100	25-100
12.	Niles	1,200	215	.....	...	120,000	559	100	P	35	100
13.	North San Juan	380	32	.....	...	15,000	469	40	M	90	.....
14.	San Fernando	2,000	500	.....	...	160,000	320	80	P	10	10
15.	San Pedro	14,000	2,645	.....	...	1,750,000	662	125	M	20- 90	20- 90
16.	Sacramento	55,000	13,520	.....	...	12,720,000	940	231	M	40	60
17.	Selma	2,500	600	.....	...	625,000	1041	250	P	50- 75	50- 75
18.	Tehama	400	100	.....	...	20,000	200	50	P	17- 25	17- 25
19.	Salinas	4,500	966	4	0.4	1,093,000	1131	243	P	36- 43	43- 80
20.	Lodi	4,000	800	4	0.5	1,440,000	1800	360	M	38- 52	38- 52
21.	Oxnard	4,000	791	6	0.8	858,000	1085	215	M	30- 45	120
22.	Hayward	3,200	1,376	12	0.9	537,000	390	168	P	10- 80	50- 80
23.	Lincoln	1,600	390	5	1.3	1,000,000	2565	625	M	70- 85	.....
24.	Hanford	6,000	1,200	20	1.7	876,000	730	146	P	50	.....
25.	Winters	1,200	310	8	2.6	300,000	967	250	M	20- 35	20- 35
26.	El Centro	6,000	1,096	30	2.7	1,500,000	1368	250	M	47- 60	47- 80
27.	Visalia	5,300	1,000	30	3.0	1,000,000	1000	189	P	40- 45	55
28.	Marysville	6,400	1,171	36	3.1	906,000	773	142	P	30	30
29.	Newport Beach	1,000	500	20	4.0	150,000	300	150	M	45	.....
30.	Redding	4,200	885	37	4.2	2,331,800	2636	555	P	42- 70	.....
31.	Pittsburg	3,600	675	30	4.4	250,000	370	69	P	15- 35	50- 60
32.	Elk Grove	500	106	5	4.7	200,000	1887	400	P	40	90
33.	Manchester Heights	800	185	10	5.4	100,000	540	125	P	15	15
34.	Tulare	3,200	800	50	6.3	1,300,000	1625	406	M	48- 55	80-125
35.	Rio Vista	900	300	20	6.7	100,000	333	111	M	55	55
36.	Reedley	1,600	400	29	7.2	400,000	1000	250	M	50	80-110
37.	Imperial	2,500	375	30	8.0	150,000	400	60	M	25- 43	45- 70
38.	Watsonville	5,600	1,700	150	8.8	1,000,000	588	179	P	25- 40	65- 80
39.	Santa Clara	6,000	1,250	125	10.	933,300	747	155	M	40	100
40.	Red Bluff	3,800	966	100	10.	900,000	930	237	P	26	.....
41.	Riverside	18,000	4,632	530	11.	4,680,000	1010	260	M	50-100	50-100
42.	Stockton	35,000	6,600	795	12.	1,479,000	224	49	P	40- 50	40- 50
43.	Victorville	560	51	6	12.	10,000	196	18	P	65	65
44.	Yuba City	1,500	260	35	14.	135,000	519	90	M	47- 60	120
45.	Sunnyvale	1,500	275	38	14.	150,000	545	100	M	12- 20	90
46.	Venice	3,100	1,000	150	15.	250,000	250	81	P	20- 60	20- 60
47.	Suisun	800	270	50	19.	250,000	925	312	M	40	65
48.	Arcata	1,120	500	100	20.	150,000	300	134	P	50- 60	85-115
49.	Whittier	7,000	1,800	400	22.	800,000	444	114	M	15- 95	45- 95
50.	Salida	150	105	25	24.	30,000	286	200	M	62- 73	62- 73
51.	Ukiah	2,400	650	160	25.	500,000	769	208	P	75- 85	75- 85
52.	Vacaville	1,200	390	100	26.	200,000	513	167	P	35	35
53.	San Francisco	477,000	64,493	20,097	31.	39,370,000	611	83	P	10-135	125-300+
54.	Fortuna	900	126	42	33.	40,000	317	44	P	80	.....
55.	Chino	2,000	457	201	44.	248,000	543	124	M	70	70
56.	Santa Cruz	15,000	3,250	1,536	47.	2,000,000	615	133	M	70- 85	70- 85
57.	Corte Madera	300	115	60	52.	30,000	261	100	P	50-150	50-150
58.	Dixon	1,000	220	115	52.	122,000	555	122	P	28- 32	70- 80
59.	San Jose	32,000	12,326	6,774	55.	6,000,000	487	187	P	45- 68	.....
60.	Vallejo	15,000	2,721	1,500	55.	1,000,000	367	67	M	80	.....
61.	Huntington Beach	2,100	502	300	60.	175,000	400	83	P	42- 48	48- 50
62.	Menlo Park	1,500	450	270	60.	219,000	486	146	P	55	55
63.	Mill Valley	2,550	1,036	620	60.	250,000	241	98	P	50-125	50-125
64.	Ceres	300	85	52	61.	75,000	882	250	P	15- 18	18- 40
65.	Mayfield	1,050	329	200	61.	150,000	456	143	M	45	45-100
66.	Elsinore	700	200	134	67.	50,000	250	71	M	.....	.....
67.	National City	5,000	1,122	770	69.	500,000	445	100	P	0- 94	0- 94
68.	Santa Barbara	12,000	4,000	2,796	70.	2,000,000	500	167	M	50-140	125
69.	Gridley	1,500	300	250	71.	300,000	1000	200	M	38- 40	80-160
70.	Los Angeles	488,000	86,954	67,225	77.	64,900,000	747	133	M	20-130	.....
			1,000	250					P	35	45
71.	Monrovia	5,500	2,014	1,557	77.	1,800,000	892	327	M	23- 56	23-108
72.	Campbell	600	187	150	80.	30,000	160	50	P	20	20
73.	Colusa	1,600	400	325	81.	500,000	1250	313	P	45- 60	160
74.	Eureka	13,500	2,430	2,043	84.	597,900	246	44	M	45- 75	45- 75
75.	Anaheim	4,500	1,400	1,200	86.	350,000	250	78	M	.....	.....
76.	Sebastopol	1,500	465	406	87.	100,000	215	67	M	35- 55	110
77.	Watts	3,300	1,000	890	89.	275,000	275	83	P	35	70
78.	Livermore	2,050	493	445	90.	239,500	485	117	P	40- 50	40- 50
79.	Alhambra	9,000	2,493	2,290	92.	1,890,000	800	210	P	20- 60	20- 60
										100-160	100-160
80.	Corona	4,500	1,035	950	92.	455,000	440	101	P	50-112	50-112
81.	Santa Ana	14,000	3,700	3,400	92.	2,211,000	597	158	M	50	50
82.	Pasadena	42,000	12,283	11,358	93.	1,206,000	99	70±	M	10- 80	10- 80
83.	Coronado	4,500	1,570	1,480	94.	500,000	318	111	P	70	70
84.	Pleasanton	1,250	496	468	94.	300,000	605	240	M	68- 80	78-110
85.	Exeter	1,700	420	400	95.	400,000	952	235	M	57	100
86.	Monterey	6,500	3,451	3,300	96.	828,000	240	127	P	40-115	40-115
87.	Palo Alto	5,500	1,382	1,323	96.	500,000	361	91	M	30- 45	75-100
88.	Benicia	2,300	475	463	97	279,300	588	121	P	.....	.....
89.	Oakdale	1,500	450	440	98.	200,000	444	133	M	40- 50	100-125
90.	Santa Monica	12,000	2,175	2,138	98.	1,150,000	529	96	P	20-110	20-110
91.	Berkeley	53,500	11,859	11,859	100.	2,710,000	228	46	P	70	70
92.	Alameda	27,000	6,342	6,342	100.	1,345,000	212	50	P	30	30
93.	El Cajon	600	300	330	100.	100,000	333	167	P	50- 90	.....
94.	Glendora	1,650	500	500	100.	300,000	600	182	M	40- 70	40- 70
95.	Hillsborough	900	40	40	100.	80,000	2000	79	P	45- 80	45- 80
96.	Inglewood	3,000	1,600	1,600	100.	1,000,000	625	333	P	20- 90	20- 90
97.	La Crescenta	250	42	42	100.	64,000	1523	256	P	.....	.....
98.	Mountain View	1,500	317	317	100.	327,500	1032	218	M	46	110
99.	Oakland	186,900	39,601	39,601	100.	11,580,000	293	58	P	23-115	23-115
100.	Ontario	6,500	1,445	1,445	100.	600,000	140	92	M	45-120	45-120
101.	Piedmont	3,000	852	852	100.	256,000	300	60	P	.....	.....
102.	Portersville	3,500	600	600	100.	500,000	833	143	M	40- 50	70-100
103.	Richmond	18,000	2,671	2,671	100.	806,000	302	60	P	.....	.....
104.	San Anselmo	2,000	200	200	100.	100,000	500	50	P	50-150	50-150
105.	San Diego	90,000	14,642	14,642	100.	7,235,000	495	80	M	20-135	20-135
			580	580					P		
106.	Sierra Madre	1,300	612	612	100.	52,000	85	40	M	50-120	50-120
107.	Taft	3,000	400	400	100.	43,000	117	19	P	60- 70	.....
		80	80	80		13,000			P		
108.	Tracy	2,000	250	250	100.	175,000	700	88	M	56	90
	Totals	1,839,430	357,420	224,331	....	205,109,000	...	..	64 P 47 M	.....	.....

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Book Reviews

OPERATION AND MAINTENANCE OF IRRIGATION SYSTEM. By S. T. Harding. P. 266. Ill., index. The McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press,' San Francisco. Price, $2.50.

The operation and maintenance of irrigation systems, as the author states in the preface, is a question of practice rather than theory, and practice necessarily varies considerably with local customs and conditions. It is probably largely for this reason that so little has been written regarding this important subject. The present volume summarizes briefly approved practice in the western part of the United States, and is based mainly upon articles in the technical press, official reports of various kinds, and upon the author's experience and investigations. The first two chapters are called 'General Maintenance' and 'Maintenance of Irrigation Systems,' but better titles would have been 'Maintenance of Canals' and 'Maintenance of Canal Structures.' Organization for operation and maintenance is then considered. The next chapter deals with the comparative merits of continuous delivery, rotation-delivery, and delivery on demand. Measurement of water, rules and regulations, and rates of payment for both construction and operation are then discussed in turn. The chapter on 'General Operation' considers several miscellaneous subjects, including a few pages regarding operations of pumping-plants. Considering the growing importance of pump-irrigation, it would seem that more space should have been devoted to this subject. The last chapter is devoted to accounting systems. An appendix contains the rules and regulations of several irrigation districts and private companies.

REPORT OF THE COMMITTEE ON PETROLEUM OF THE STATE COUNCIL OF DEFENSE. P. 191, with 41 plates and 34 statistical tables. California State Printing Office, Sacramento.

Besides being an authoritative presentation of the facts regarding the present oil-shortage and the best means of meeting it, this volume is probably the most complete and up-to-date treatise in existence on the Californian petroleum industry. After a general discussion of the world petroleum situation, the Californian fields are considered and a brief history of the withdrawals of oil-land and subsequent litigation is given. Then chapters are devoted to the production, storage, transportation, refining, and utilization of Californian petroleum. Methods of maintaining and increasing production are considered, as well as methods of conservation. It is shown that no considerable decrease in consumption is possible for several years to come without seriously interfering with the railroads and industries of the Pacific Coast, and that increased production is necessary for the welfare of the public. This increased production can probably be obtained only by opening to development at least part of the land now in litigation. The final chapter, an abstract of which was recently published in WESTERN ENGINEERING, is devoted to recommendations regarding means for meeting the present situation as regards oil-shortage.

REINFORCED CONCRETE DESIGN TABLES. By M. Edgar Thomas and Charles E. Nichols. Pp. 208. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

This volume is intended to fill the same place in reinforced concrete design as the various steel handbooks do in their field. The principal tables are for slabs and simple beams, tee-beams, beams with compression-reinforcement, square columns, hooped columns, hooped-column reinforcement, vertical-column reinforcement, spacing and percentages of column-hooping. The tables have been computed for wide range of values for the working stress of steel and concrete, and for the ratio between the moduli of elasticity of steel and concrete.

WHARVES AND PIERS. By Carleton Greene. Pp. 241. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

Although it has been recognized for many years that the efficiency of water-transportation depends largely upon the terminals, there is comparatively little published information regarding the design of such terminals. The introductory chapters discuss materials of construction and the fundamental principles of design. The succeeding chapters deal with timber construction, retaining-walls, piers, wharf and pier sheds, equipment of wharves and piers, and cargo-handling machinery. An appendix contains several pages of valuable cost-data. Examples of construction are given from various parts of the United States, and a few from foreign countries.

Industrial Progress

CEMENT AND SHALE BRICK*

By JOHN MEAGHER

Bricks made from portland cement and shale are being manufactured by the Builders' Brick & Manufacturing Co. of Kansas City under a patented process controlled by the National Burned Clay Concrete Co. The clay and shale is burned in a 16-ft. portable rotary kiln at a temperature between 1700° and 2200°F., according to the character of the material. The output of the kiln is 100 cu. yd. per 24 hours. When discharged from the kiln is 100 cu. yd. per 24 hours. When discharged from the kiln, the burned material is allowed to cool in the air, and is then sprinkled with water to slack any lime particles that may be present. The burned material is then graded by screening, and is then mixed with cement in a concrete-mixer using about the same proportions as for ordinary concrete. About 20% of water is used.

An ordinary shale-brick press with a capacity of 20,000 bricks per day is used to make the bricks. When discharged from the press, the bricks are left undisturbed for from 12 to 24 hours and are then piled to cure. From 8 to 14 days is required for curing, the bricks being sprinkled occasionally to prevent too rapid drying. When cured the bricks are a light gray. They weigh 4½ lb. apiece, or 96 lb. per cu. ft., against 6 lb. apiece for clay or shale bricks. The cost of these bricks is about the same as ordinary clay or shale bricks.

Tests of these bricks at 60 days showed crushing-strengths from 1810 lb. to 2220 lb. per sq. in. and transverse-strengths from 1455 to 2055 lb. per sq. in. Comparative fire-tests were made as follows: The bricks were heated to a given temperature and then immersed in cold water immediately after being taken from the furnace. After the specimens had cooled completely, they were tested for crushing-strength. The clay bricks were tested at only one temperature, 1700° F. The following strengths in pounds per square inch were noted:

	Clay and burned-shale concrete, 1:7 mix	Sand and stone concrete, 1:2:4 mix	Clay brick
Room temperature.....	2024	2260	....
750°F.	1720	2100	....
1150°F.	1709	1900	....
1300°F.	1701	1850	....
1700°F.	1690	failed	failed
1900°F.	540	failed	....
2200°F.	fused to fluid	....	....

*Abstract from 'Portland Cement'.

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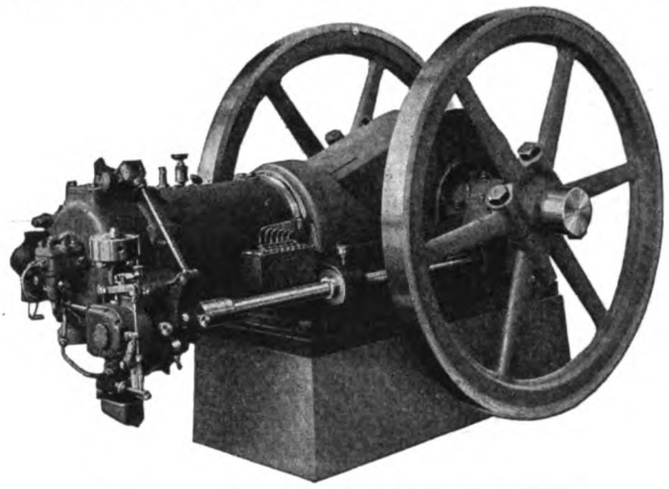
THE DOAK OIL-ENGINE

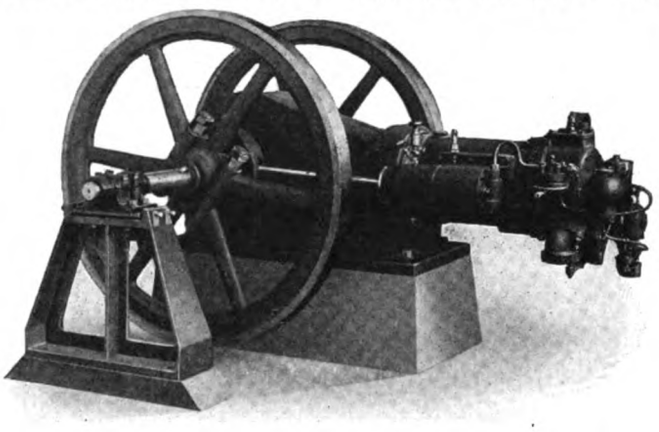
Announcement is made that the Doak Gas Engine Co., Cunard building, San Francisco, has acquired the sole right to manufacture and sell oil-engines in the United States and its possessions under patents owned by Blackstone & Co., Ltd., of Stamford, England. The oil-engine manufactured by the Blackstone company in its present form is the result of many years experience, combined with the performance of their engines under working conditions. Thus the Doak company, through securing the American rights for the manufacture of this engine, is enabled to offer to American power users an engine that has been perfected and has proved its worth through many hundreds of engines in every-day use. The



DOAK OIL-ENGINE, SHOWING VALVE MECHANISM

Doak oil-engine, as it is known, is of the low compression, so-called semi-Diesel type. Ignition is effected by means of a hot bulb. The essential feature of the Blackstone patents consists of the use of two fuel sprays, called the ignition spray and the main spray. The ignition spray is directed against the hot bulb by which it is ignited. The ignition spray is directed across the path of the main spray, and ignites it. The quantity of fuel used by the ignition spray is fixed at all times, thus constant temperature is maintained for the hot bulb under all conditions of load. The importance of this feature cannot be over-estimated as users of the ordinary type of hot-bulb engines have experienced much trouble through a drop in temperature of the hot bulb when the engine is operating under fractional loads, causing incomplete combustion of the fuel and loss of power and efficiency. The quantity of oil ejected from the main spray is regulated by a governor to suit the load under which the engine is operating. The constant temperature at which the hot bulb is maintained enables the engine to respond to wide fluctuations in load almost instantly, although the engine may have been operating at a light load over a prolonged period. The fuel-valve operating mechanism is so arranged that it is a simple matter to time the opening of the fuel-valves. The time of ignition may be advanced or retarded at will, thus pre-ignition is impossible and it is unnecessary to inject water into the combustion-chamber under any conditions. The governor is of the centrifugal type, and controls the speed of the engine by regulating the stroke of the fuel-pump. The engine is provided with a two-stage air-compressor built integral for furnishing compressed air for starting and fuel atomization. The engine may be started readily by hand, should necessity arise. Compressed air is delivered by the compressor to air-bottles from which a supply of high-pressure air is always available for starting purposes. The Doak oil-engine has been proved to operate satisfactorily on any fuel-oil suitable for a Diesel engine. If necessary, by reason of local conditions, asphaltic-base oils as low as 18° Baumé and carrying 50% asphalt can be used. This necessity, however, seldom arises. The oil that has been found most satisfactory is a fuel-oil 23 to 24° Baumé, carrying not to exceed 25% asphalt and 1% sulphur. When using an oil of the latter characteristics, the manufacturers guarantee a fuel consumption not to exceed 0.5 lb. at full load and 0.6 lb. at three-quarter load. Actual experience has proved the above figures to be conservative.

Power users may thus obtain an oil-engine that has many advantages over existing types, without any of their disadvantages. The use of the hot bulb for ignition, combined with the features of constant temperature and practically perfect combustion at all loads, is one that will appeal instantly to those who have had experience with other oil-engines. The



DOAK OIL-ENGINE, SHOWING INTEGRAL AIR-COMPRESSOR

comparatively low compression and initial pressures maintained in the cylinder eliminate shock and excessive internal stresses and strains. Bearings will always run cool with a minimum of attention and permit a comparatively light construction, reducing installation and transportation-costs. The engine is constructed in both the horizontal and vertical types, adapted for stationary and marine service as well as for hoisting. The four-stroke cycle is used exclusively. The sizes range from 35 to 240 hp. The Doak company has been engaged in the manufacture of internal-combustion engines since 1889 and has established an enviable reputation for care and accuracy in manufacturing, which carries an assurance of satisfactory performance to prospective users of the Doak oil-engine.

Engineering Societies

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. J. A. Currey, secretary, 194 North 13th street, Portland.

San Francisco Section of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

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San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carl F. Braun, secretary, Hooker & Lent building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Wilkie Woodard, secretary, 435 Consolidated Realty building, Los Angeles.

UTAH SOCIETY OF ENGINEERS. Hugh C. Lewis, secretary, Capitol building, Salt Lake City, Utah.

THE OREGON SOCIETY OF ENGINEERS held its first meeting after the summer recess on September 20. Franklin T. Griffith, president of the Portland Railway, Light & Power Co., discussed the question of increased street-railway fares.

THE SAN FRANCISCO SECTION of the American Institute of Electrical Engineers met on September 28 at the rooms of the Engineers' Club. J. D. Galloway addressed the association on 'The Civilian Engineer and the War,' and Frank Rieber spoke on 'Engineering Problems of the War.'

A JOINT MEETING of the San Francisco Sections of the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, and American Chemical Society will be held October 25 in honor of Ira N. Hollis, president of the American Society of Mechanical Engineers, who will speak on 'The Moral Influence of Engineering and Efficiency.'

AN OPEN MEETING of the California Section of the American Chemical Society was held at San Francisco on September 29 at which the relation of the chemist to the War was discussed.

Personal

B. K. STROUD is in San Francisco.

L. G. WILLIAMS has been appointed city engineer of Santa Cruz.

J. H. DOCKWEILER has been appointed a member of the Federal Waterways Commission.

CHARLES F. WIELAND, of the Ordnance Department, U. S. A., will leave for Manila early in October.

HOWARD F. CLARK has gone to Fort Leavenworth, Kansas, to attend the Reserve Officers' Training Camp.

F. W. GAY has gone to New York to be Atlantic district manager for the Pelton Water Wheel Company.

W. H. STEARNS has been appointed assistant chief engineer for the Sacramento County Highway Commission.

W. S. FARLEY has been appointed engineer for the newly-incorporated municipality of El Cerrito, California.

DOMINGO NOGUÉS is in California, studying industrial and engineering conditions for the Argentine Government.

R. V. ORBISON, city engineer of Pasadena, attended the annual convention of the League of California Municipalities at Santa Rosa.

BENN DUFFIELD, county surveyor of Kings county, California, has gone to Fort Leavenworth, Kansas, to attend the Reserve Officers' Training Camp.

F. T. ROBSON, captain in the Engineer Officers' Reserve Corps, has gone to Atlanta, Georgia, to assist in instruction at the training-camp at that place.

H. E. HILTS, formerly district engineer for the Portland Cement Association, with headquarters at San Francisco, has been appointed general manager for the Association, succeeding J. P. BECK, deceased.

PAUL M. PAINE, for several years field-superintendent for the Honolulu Oil Co., with headquarters at Taft, California, will leave for Tulsa, Oklahoma, during October, to take a position with the Gypsy Oil Company.

The headquarters of the Pacific Coast division of the U. S. Office of Public Roads will be moved about October 1 from Berkeley to the Mills Bdg., San Francisco. C. H. SWEETSER is district engineer, and W. H. LYNCH, senior highway engineer.

HENRY L. BOWLBY has been appointed senior highway engineer for the U. S. Office of Public Roads, with headquarters at Denver. Mr. Bowlby was State highway engineer of Washington from 1909 to 1911 and State highway engineer for Oregon from 1913 to 1915.

D. D. CLARKE, for the past twenty years chief engineer of the municipal water department of Portland, Oregon, has resigned on account of ill-health. He has been succeeded by F. M. RANDLETT, former principal assistant engineer for the department, who in turn was succeeded by BEN MORROW, who has been on the engineering staff of the department.

The following district oil and gas commissioners were elected September 17 in the various Californian districts. This was the first election under the new law. The commissioners will co-operate with the State oil and gas supervisor and his deputies in protecting the oilfields against damage from improper drilling-methods. District No. 1, comprising Los Angeles and Orange counties, ROSCOE W. STEPHENS, WILLIAM KAMMERER, W. H. CLARK, WALTER G. BLACK, and F. F. HILL. District No. 2, comprising Ventura county, WILLIAM STEIN. DAVID MARTIN, LEWIS D. HILTON, W. E. COAN, and E. E. CHAMBERLAIN. District No. 3, comprising Santa Barbara and San Luis Obispo counties, W. PENYER, THOMAS COLLINS, J. U. STAIR, E. E. CRITCHLOW, and W. CANFIELD. District No. 4, comprising Kern county, GEORGE KAMMERER, C. E. BALLAGH, R. A. SPERRY, THOMAS SAINE, J. B. NEWTON, E. J. SCHNEIDER, and P. A. WILLIAMS. District No. 5, comprising Fresno county, J. B. THOMPSON, H. G. ANDERSON, S. H. HAIN, C. A. HIVELY, and WILLIAM C. MCDUFFIE.

Obituary

JAMES P. BECK, general manager for the Portland Cement Association, died at Chicago, September 8.

CHARLES L. CRANDALL, emeritus professor of railway engineering at Cornell University, died at Ithaca, New York, August 25.

JOHN R. TIMMONS died at Oklahoma City, Oklahoma, September 17. Mr. Timmons was one of the organizers of the Standard Oil Co. and had built and operated many oil-refineries in different parts of the country. Although 78 years old at the time of his death, he had just completed the construction of a plant for the Home Refining Company.

Commercial Paragraphs

LEWIS S. LOUER has purchased a half-interest in 'Engineering and Contracting', thus becoming joint owner with Halbert P. Gillette of the common stock of the company.

THE editorial and advertising departments of 'Municipal Engineering' will have their headquarters at 538 South Clark street, Chicago. The business office will remain at Indianapolis.

Manufacturers of clay products, particularly brick, have found it hard to obtain a protective coating for the steel cars used in conveying fresh brick through the dry-tunnels prior to burning. Comparatively high temperatures are maintained in these tunnels, in which the cars remain from two to four days. The moisture and heat cause rapid deterioration of metal surfaces. ORONITE ENAMEL PAINT has been used successfully to meet these conditions. One method is to dip the entire car in a tank containing the paint or else it may be applied with a brush.

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New Publications

CONCRETE TILE FOR LAND DRAINAGE. The Portland Cement Association. Pp. 10. Ill. Describes the methods of making and laying concrete tile.

The SULLIVAN MACHINERY CO. has issued three bulletins, describing, respectively, the rock-drills, submarine rock-drills, and diamond-core drills manufactured by the company.

THE FIGHT AGAINST FIRE. By Franklin H. Wentworth. Pp. 8. The Portland Cement Association. Discusses the use of fire-resisting material and other fire-prevention measures.

BULK CEMENT. The Portland Cement Association, 111 West Washington street, Chicago. Pp. 12. Shows the advantage of using bulk cement over sack cement on many classes of construction.

PROTECTING CONCRETE WORK DONE IN WARM WEATHER. The Portland Cement Association. Pp. 8. Ill. The methods described include ponding and diking, earth covering, and the use of canvas or other shade.

The GENERAL ELECTRIC CO. has issued bulletin No. 47380-A describing Safety-First Combined Lever Switches and Fuses, and bulletin No. 48319-A, describing Pressure-Controlled Speed-Regulating Panels with Automatic Pressure-Regulator.

LIMITS OF COMPLETE INFLAMMABILITY OF MIXTURES OF MINE GASES AND OF INDUSTRIAL GASES WITH AIR. By G. A. Burrell and A. W. Gauger. Technical Paper No. 150 of the Bureau of Mines. P. 14. Ill. Gives results of tests on the principal inflammable gases.

THE UTILIZATION OF PYRITE OCCURRING IN ILLINOIS BITUMINOUS COAL. By E. A. Holbrook. Engineering Experiment Station, University of Illinois, Urbana. Shows that there are important commercial possibilities connected with the recovery of pyrite in bituminous coal.

THE OREGON BASIN GAS AND OIL FIELD. Bulletin No. 15 of the office of the State Geologist of Wyoming. Pp. 32. Ill. There are some favorable indications in this field, but though 11 wells have been drilled and some gas obtained, there has been no commercial production of oil.

USE OF MEAN SEA-LEVEL AS THE DATUM FOR ELEVATION. By E. Lester Jones. Special publication No. 41, U. S. Coast and Geodetic Survey. Pp. 21.

Shows the advantage of adopting mean sea-level as a datum wherever possible, as is done by both the U. S. Coast and Geodetic Survey and the U. S. Geological Survey.

REFORT OF THE BRITISH COLUMBIA HYDROMETRIC SURVEY FOR 1915. Water Resources Paper No. 18. Pp. 438. Ill., index. REPORT OF THE MANITOBA HYDROMETRIC SURVEY FOR 1915. Water Resources Paper No. 19. Pp. 269. Ill., index. The Dominion Water Power Branch, Department of the Interior, Ottawa. These two reports discuss part of the varied and valuable work that the Dominion Water Power Branch is continuing, even in war times.

IN RE THEORETICAL DEPRECIATION. By James E. Allison. James E. Allison & Co., St. Louis. Pp. 155. Ill. This is a discussion by a prominent valuation engineer of one of the most important problems in connection with valuation of public utilities. The author holds that a reduction in reproduction cost of a property on account of theoretical depreciation is not justified, provided that the property is properly maintained and is practically 100% efficient. The pamphlet is divided into three parts, Part I being a general discussion of the subject, Part II answering specifically the arguments of a particular paper upholding the other side of the question, while Part III is devoted to the principal judicial decisions on the subject.

Construction News Summary

STREET AND ROAD WORK

Berkeley, Cal.—Bids will be received until October 5 by A. G. Briggs, city clerk, for construction of concrete sidewalks on several streets.

Coeur d'Alene, Ida.—Formation of highway district has been ratified at election. Total cost of work, including Federal and State appropriations, will be $150,000.

Colfax, Wash.—Construction of highway from Ewan to Steptoe, 23 miles, is proposed. Estimated cost is $200,000.

Contract for grading, graveling, and construction of concrete gutters on Thorn street has been awarded to M. E. Thomas, Colfax, for $5220.

Colusa, Cal.—Construction of concrete highway between Princeton and Grimes has been proposed. Estimated cost is $70,000.

Exeter, Cal.—City engineer H. D. Watts is preparing plans for paving several streets.

Ferndale, Wash.—Contract for construction of concrete pavement on Third street and other streets has been awarded to Charles Lind, Bellingham, for $15,214.

Fresno, Cal.—Worswick Street Paving Co., Fresno, has been awarded contract for grading and construction of concrete curbs, sidewalks, and gutters in vicinity of Southern Pacific passenger-station. Estimated cost is $7000.

Green Creek, Ida.—Bids will be received until October 8 by J. A. Johnson, clerk of Green Creek highway district, for construction of about three miles of Green Creek highway.

Hoquiam, Wash.—Contract for furnishing gravel for road-surfacing has been awarded to Grays Harbor Construction Co. for 85c. per cubic yard.

Los Angeles, Cal.—Because of irregularity in the lowest bid for improvement of First street, all bids were rejected and work will be readvertised. Estimated cost is $200,000.

Los Angeles, Cal.—Contract for improvement of Burns avenue has been awarded to E. S. Groshong, Burbank, for $5982.39.

Martinez, Cal.—Contract for improvement of highway between Martinez and Peyton has been awarded to W. E. Price.

Contract for grading Escobar street has been awarded to W. E. Price, Martinez, at $1.10 per cu. yd., or $17.60 in all. W. R. Shelby bid $2080.

Marysville, Cal.—Contract for improvement of La Porte road has been awarded to D. C. Hogue, Marysville, for 48c. per cubic yard.

Modesto, Cal.—Bids will be received until October 9 by H. Benson, county clerk, for construction of 16.67 miles of concrete pavement; 2.88 miles on the Hickman-Thalheim road, 8.22 miles on the Waterford road, and 5.57 miles on the Oakdale-Waterford road.

Monrovia, Cal.—Contract for improvement of several streets has been awarded to B. R. Davisson Contracting Co., 417 South Myrtle street, Monrovia.

Oakland, Cal.—Contract for improvement of 29th avenue and East 17th street has been awarded to Oakland Paving Co., 5000 Broadway, Oakland, at 2½c. per sq. ft. for grading, 40c. per ft. for concrete curbs, 14c. per sq. ft. for concrete gutters, and 9c. per sq. ft. for oil-macadam pavement.

Contract for improvement of High street has been awarded to Hutchinson Co. at the following unit prices: grading and construction of oil-macadam pavement, 11c. per sq. ft.; concrete gutters, 17c. per sq. ft.; concrete sidewalks, 10c. per sq. ft.; concrete curbs, 49c. per foot.

Contract for improvement of parts of East 22nd street and Austin street has been awarded to Hutchinson Co., 422 17th street, Oakland, at the following unit prices: grading and construction of oil-macadam pavement, 10c. per sq. ft.; concrete gutters, 17c. per sq. ft.; concrete curbs, 40c. per foot.

Olympia, Wash.—Contract for construction of 5½ miles of Inland Empire highway between Touchet and Walla Walla has been awarded to J. W. Hastings, Spokane, for $9005.04. Engineers' estimate was $10,014.

State Highway Commission has rejected all bids for construction of two miles of Sunset highway between Cle Elum and Ellensburg, and new call for bids will be issued.

Following bids were received for construction of five miles of Inland Empire highway from Dayton northerly: C. N. Pentecost, Walla Walla, $32,878; G. L. Stickler, Uniontown, $34,812. Bids were taken under advisement.

About $9,000,000 will be spent on highway construction and maintenance by the various counties in the State during 1918.

Oxnard, Cal.—Contract for construction of warrenite pavement on concrete base on several streets has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $5000.

Phoenix, Ariz.—Contract for improvement of East Moreland street has been awarded to Southwestern Construction Company.

Placerville, Cal.—Board of Supervisors has decided to postpone improvement of road between city and Chile Bar bridge because of lack of funds. Estimated cost is $3000.

Pocatello, Ida.—Contracts for street improvements in districts No. 10 and 12 have been awarded to J. J. Carroll for $3464 and $8434, respectively. Contract for improvements in district No. 22 has been awarded to Strange-Maguire Paving Co. for $8424.

Port Angeles, Wash.—Contract for construction of gravel-surfaced highway along waterfront has been awarded to A. L. Johnson & Co., for $7547.

Portland, Ore.—Warren Construction Co., Portland, was low bidder at $1.60 per sq. yd. or $20,391.47 for construction of gravel-bitulithic pavement on streets in Rose City park district. Oskar Huber bid $21,231.

Contract for construction of ten miles of state highway in Douglas county between Oakland and Yoncalla has been awarded to Warren Construction Co., Portland, for $94,905.74. H. Hildenburn, Roseburg, and W. T. Johns, Portland, also submitted bids on this work.

Contract for grading state highway between Comstock and Leona has been awarded to Hall & Solium, Eugene, for $57,946.02. Warren Construction Co. bid $62,115.12.

Contract for construction of state highway between Leona and Lane county line has been awarded to S. S. Schell, Roseburg, for $26,787.

Contract for construction of 8 miles of state highway between Oregon City and Canby has been awarded to Oregon Hassam Paving Co., Portland, for $145,721.

Redding, Cal.—Bids will be received until November 8 by S. N. Witherow, county clerk, for construction of three miles of wagon-road near McCloud river.

Richmond, Cal.—Contract for construction of concrete pavement with asphaltic wearing surface on 10th street has been awarded to L. L. Page, for $25,399.46. Other bidders were: S. C. Rogers, $27,567.40; Municipal Improvement Co., $30,635.32; and G. W. Cushing, $31,156.54.

Contract for improvement of Standard avenue has been awarded to L. L.

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Page, 8th and Bissell streets, Richmond, for $13,105. Municipal Improvement Co. bid $13,333.30.

Riverside, Cal.—Contract for improvement of Yorba street in Corona has been awarded to E. L. Fleming for $2497.35.

Sacramento, Cal.—Following were the unit prices named by A. Robinson and R. R. Smith, who were awarded contract for construction of 7.2 miles of state highway between Rio Dell and Fortuna, in Humboldt county: excavation, $0.40 per cu. yd.; borrow, $0.80 per cu. yd.; 12-in. metal pipe, $0.50 per ft.; 18-in. pipe, $0.75; 24-in., $1; 30-in. pipe, $1.50; class A concrete, $12 per cu. yd.; monuments, $0.50 each. Other bidders were: J. A. Marshall, $48,877.20; W. A. Bechtel, $62,708.55; Tieslau Bros., $69,912.90; A. J. Fairbanks, $82,673. Engineers' estimate was $48,407.41.

Contract for grading 10.8 miles of state highway in Shasta county between Redding and Bayha has been awarded to Palmer & McBryde, 503 Market street, San Francisco, at $59,541.

Contract for grading 4.5 miles of state highway in San Diego county between Guatay creek and Pine valley has been awarded to W. M. Ledbetter, Pacific Electric Bdg., Los Angeles, for $25,458.50.

Detailed figures regarding the state highway work, bids for which will be received until October 8 by State Highway Commission, are now available: The work in Butte county between the southerly boundary and Biggs, 7.7 miles, will require 10,500 cu. yd. excavation, 210 ft. of 12 to 24-in. corrugated metal pipe, 150 cu. yd. concrete in culverts and monuments, 7600 cu. yd. concrete in pavement, 200 ft. guard-rail, and 58 monuments. State will furnish pipe-railing, reinforcing-steel, corrugated-metal pipe, cement, sand, and coarse aggregate.

The work in Sonoma county between Santa Rosa and Willow Brook, 12.4 miles, will require 42,000 cu. yd. excavation, 782 ft. 12 to 24-in. corrugated pipe, 850 cu. yd. concrete in culverts and monuments, 12,200 cu. yd. concrete in pavement, 482,000 sq. ft. of reinforcement in pavement, 8000 ft. guard-rail, and 131 monuments. State will furnish pipe-railing, reinforcing-steel, reinforcement for pavement, corrugated pipe, cement, sand, and coarse aggregate.

The work in Marin county, between the northerly boundary and San Rafael, 16 miles, will require 97,000 cu. yd. excavation, 2668 ft. 12 to 30-in. corrugated pipe, 795 cu. yd. concrete in culverts and monuments, 15,700 cu. yd. concrete in pavement, 195,000 sq. ft. reinforcement for pavement, 5225 ft. guard-rail, and 201 monuments. State will furnish the same materials as for the Sonoma county contract.

Contract for grading and construction of concrete curbs and gutters and asphaltic concrete pavement on concrete base on Castro way has been awarded to A. Teichert & Son, Sacramento.

Salem, Ore.—State Highway Commission has decided to construct highway along Columbia river from Hood River to The Dalles, 5.8 miles. Estimated cost is $302,000.

Salt Lake City, Utah.—Plans have been completed by Lincoln Highway Association for construction of highway across the Great Salt Lake desert. Estimated cost is $157,000.

San Anselmo, Cal.—Bids for street improvements were received from Clark & Henery Construction Co., Municipal Improvement Co., Johnson-Shea Co., and H. Crummey. The lowest bid was $7000 above the engineer's estimate, and all bids were rejected.

San Bernardino, Cal.—Contract for improvement of South Arrowhead avenue has been awarded to Highway Construction Co. at 11c. per sq. ft. for paving, and 30c. per ft. for concrete curbs.

Contract for oiling part of Arrowhead avenue has been awarded to Johnson-Shea Co., San Bernardino, for 4.5c. per square foot.

San Diego, Cal.—Six miles of concrete highway and eight miles of gravel and decomposed-granite highway will be constructed at Camp Kearny. Work will be done by W. E. Hampton, general contractor on the work.

San Francisco, Cal.—Contract for improvement of Silliman street has been awarded to Blanchard-Brown Co., Call Bdg., San Francisco, at the following unit prices: concrete curbs, 90c. per ft; asphalt pavement, 26c. per square foot.

Contract for construction of concrete sidewalks on Chestnut street has been awarded to Frank O'Shea for 17c. per square foot.

Contract for improvement of Alvarado street has been awarded to James M. Smith, 407 11th street, San Francisco, at the following unit prices: excavation, $1.50 per cu. yd.; 8-in. sewers, $2.90 per ft.; brick manholes, $80 each; armored concrete curbs, $0.85 per ft.; concrete sidewalks, $0.14 per sq. ft.; vitrified-brick pavement, $0.41 per sq. ft.; asphalt pavement, $0.25 per square foot.

Contract for improvement of Flood avenue has been awarded to Flinn & Treacy, First National Bank Bdg., San Francisco, for 80c. per ft, for concrete curbs and 26c. per sq. ft. for asphalt pavement.

Contract for improvement of Clayton street has been awarded to Flinn & Treacy at the following unit prices: asphalt pavement, $0.29 per sq. ft.; basalt-block pavement, $0.45 per sq. ft.; granite curbs, $1.25 per ft.; concrete sidewalks, $0.14 per square foot.

Cantract for improvement of Sickles avenue has been awarded to J. F. Dowling at $1.50 per ft. for granite curbs and $0.25 per sq. ft. for asphalt pavement.

San Jose, Cal.—Contract for improvement of Bodfish Mill road has been awarded to Kunze Contracting Co., San Francisco, for $45,496.

All bids for improvement of Santa Clara and Alviso road have been rejected because of there being no funds available.

Following bids were received for improvement of San Aquino road: Raisch Improvement Co., $22,245 for topeka. E. M. Chadbourne, $20,865 and $16,865 for bitucrete. F. R. Ritchie, $17,865 for topeka. Western Construction Co., $16,000 for oil-macadam. Bernard Ransome, $20,800 for topeka, and $16,584 for oil-macadam. John F. Adams, $21,900 for topeka. Engineer's estimate was $21,380 for topeka, $15,930 for bitucrete, and $13,940 for oil-macadam. All bids were rejected.

San Rafael, Cal.—Contract for improvement of Villa avenue has been awarded to Blake Bros., Oakland, at the following unit prices: grading, $0.40 per sq. ft.; macadam pavement, $0.075 per sq. ft; richmondite surface, $0.035 per sq. ft.; concrete curbs, $0.39 per ft.; concrete gutters, $0.29 per lin. ft.; 5 by 30-in. corrugated-metal culverts, $2.50 per ft.; 3 by 3-ft. concrete culverts, $2.50 per ft.; 24 by 24-in. gratings, $30 each.

Bids will be received until October 8 by E. W. Smith, county clerk, for construction of bituminous wearing surface on the existing macadam roadway on Grand avenue.

Santa Ana, Cal.—Bids are being received by W. B. Williams, county clerk, for paving streets at Laguna Beach and San Juan Capistrano and for paving the Hot Springs road near San Juan Capistrano.

Contract for improvement of part of Brea-Olinda road has been awarded to Wright & Wood, Santa Ana, for $3398. Wells & Bressler bid $4284 and J. S. Fluor, $4451.

Santa Barbara, Cal.—Contract for grading and construction of concrete curbs, gutters, and sidewalks on Victoria street has been awarded to A. L. Pendola, 1332 Garden street, Santa Barbara, for $3122. J. T. Cornwall bid $3182.

Because of technical error in proceedings, contract for improvement of State street, which had been awarded to Fairchild-Gilmore-Wilton Co. for $27,000, has been rescinded and a new call for bids will be issued.

Contract for paving Montecito street has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $7464.15. Engineer's estimate was $7335.31.

Santa Monica, Cal.—Contract for improvement of 18th avenue has been awarded to Frank Ockert at 1.65c. per sq. ft. for grading, 5.8c. per sq. ft. for macadam pavement, 32c. per ft. for concrete curbs, and 11c. per sq. ft. for concrete sidewalks.

Santa Rosa, Cal.—All bids for construction of asphaltic wearing-surface on three miles of highway have been rejected, and work will be done by day-labor.

Seattle, Wash.—Contract for grading alley in district No. 3091 has been awarded to Espeland Bros., Mutual Life Bdg., Seattle, for $1253.50.

Contract for paving Valley street has been awarded to F. N. Badalato, 1642 Lane street, Seattle, for $9462.

Contract for grading Court and other streets has been awarded to Espeland Bros. for $13,615.50.

Contract for paving and construction of sewers on Latona avenue has been awarded to R. G. Stevenson, 1327 Ewing street, Seattle, for $27,-610.10.

Contract for paving 14th avenue Northeast has been awarded to R. G. Stevenson for $8153.30.

Bids for construction of Auburn-Enumclaw highway have been rejected and work has been postponed until next spring.

Stockton, Cal.—Bids will be received until October 10 by E. D. Graham, city clerk, for improvement of five miles of the I. L. Borden road, southwesterly from Holt.

Susanville, Cal.—Election has been called for October 20 to vote on formation of highway district comprising supervisorial districts No. 1, 2, and 3. Bond issue of $60,000 is proposed, which, with an appropriation of an equal amount made by the last legislature is to be used for construction of a highway from Susanville to the state line near Reno.

Vallejo, Cal.—Contract for street improvements in south central part of city has been awarded to Worswick Construction Co., Vallejo, at $0.64 per cu. yd. for excavation, $0.15 per sq. ft. for bitulithic pavement on concrete base, $0.15 per sq. ft. for plain concrete pavement, $0.135 per sq. ft. for concrete sidewalks; a total of $80,293.84. Johnson-Shea Co. bid $86,-543.03, and Clark & Henery Construction Co., $88,854.14.

Ventura, Cal.—C. Hallin and A. W. McFadden, 2111 Santa Cruz street, Los Angeles, were the only bidders and were awarded contract for construction of concrete highway between Fillmore and the Guiberson road, at $5002.32.

Contract for grading, oiling, and tamping driveways of the Ivy Lawn Cemetery has been awarded to Conner Contracting Co., Higgins Bdg., Los Angeles, for $6000.

Contract for improvement of East Main street has been awarded to Andrew Holloway, 471 South Broadway, Pasadena, at $0.25 per cu. yd. for excavation, $0.10 per ft. for shaping roadbed, and $4 per cu. yd. for concrete, a total of $7392.75. Connor Contracting Co. bid $8922.

Visalia, Cal.—Bids will be received until October 5 by George R. Prestidge, county clerk, for construction of the Dinuba-Kingsburg, Exeter-Merryman, Tulare-Paige, and Porterville-Woodville divisions of the county highway system.

Wallace, Ida.—Contract for paving in district No. 7 has been awarded to Henry J. Kaiser, Everett, at $1.50 per sq. yd. for a 2-in. bitulithic surface on a 3-in. macadam base, a total of $12,637.

Washington, D. C.—The following amounts have been allotted for highway construction in Western States under the Federal Aid Road Act for the year ending June 30, 1919: Arizona, $205,540; California, $456,187; Idaho, $182,471; Nevada, $193,229; New Mexico, $238,634; Oregon, $236,322; and Washington, $216,530. These appropriations are all conditional upon the State's appropriating an equal amount.

Watsonville, Cal.—Contract for improvement of West Third street has been awarded to Granite Rock Co., Salinas, at the following unit prices: grading, 2c. per sq. ft.; macadam pavement, 9c. per sq. ft.; oiling, 2c. per sq. ft.; concrete gutters, 18½c. per sq. ft.; concrete curbs, 50c. per foot.

Woodland, Cal.—Clark & Henery Construction Co., Sacramento, was low bidder for improvement of North street and South 4th street at the following unit prices: grading, $0.019 per sq. ft.; warrenite pavement, $0.1485 per sq. ft.; corrugated culverts, $2 per ft.; basalt-block headers, $0.1485 per sq. ft. Federal Construction Co., H. Crummey Co., and A. Teichert & Son also bid on the work.

Yreka, Cal.—Contract for construction of four miles of Forest-House-Etna road has been awarded to Albert Anderson Co., Yreka, for $11,800.

SEWERS AND DRAINAGE

Astoria, Ore.—Contract for construction of sewers in Scow Bay district has been awarded to Coluccio and Moceri, Seattle, for $43,900.

Eureka, Cal.—Contract for construction of sewer on West avenue has been awarded to Elsemere & Jacobs, Eureka, for $1789.

Los Angeles, Cal.—Contract for construction of sewer on Lake street has been awarded to Leo Miletich for $3397.

Oakland, Cal.—Contract for construction of sewer on Marin way has been awarded to J. Catucci, 1212 18th avenue, Oakland, at 90c. per ft. for 8-in. sewers, and 50c. per ft. for wye-branches.

Portland, Ore.—J. F. Shea was low bidder at $16,460.47 for construction of sewers on 65th street and other streets. Other bidders were: Lindstrom Bros., $17,851.65; Jacobsen-Jensen Co., $18,695.90; Azar & Co., $18,767.55.

Richmond, Cal.—Contract for construction of sewers on Redwood avenue has been awarded to F. Meyers, Richmond, for $887. T. Clinch bid $1023.24 and L. L. Page, $1188.50.

Sacramento, Cal.—Contract for construction of 8-in. sewers on several streets and alleys has been awarded to J. W. Terrell.

San Francisco, Cal.—Contract for construction of sewers on Burrows street has been awarded to P. A. Belser at the following unit prices: 8-in. sewer, $1.40 per ft.; 12-in. sewer, $1.50; 6-in. sewer, $0.80 per ft.; 8-in. wye-branches, $1 each; brick manholes, $70 each.

Santa Barbara, Cal.—Contract for construction of sewers on Alamar street has been awarded to A. A. Lemon, Santa Barbara, for $1963. J. T. Cornwall bid $2229. Engineer's estimate was $2000.

Contract for construction of sewers on Milpas and Anapamu streets has been awarded to J. T. Cornwall, Santa Barbara, for $18,128. Engineer's estimate was $15,600.

Bids will be received until noon, October 18, by A. C. Hall, city clerk, for improvement of sewer system, including pipe-sewers, sewage-treatment plant, and outfall sewer. Plans from Olmsted & Gillelen, Hollingsworth Bdg., Los Angeles, upon deposit of $2.

Stockton, Cal.—Contracts for construction of sewers on South street and in the northern addition to city have been awarded to E. A. Bruns at $1566.90 and $381.70, respectively.

BRIDGES AND CULVERTS

Ephrata, Wash.—Bids will be received until October 6 by C. T. Sanders, county clerk, for construction of two concrete bridges.

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Eugene, Ore.—Contract for construction of Thurston bridge has been awarded to W. O. Heckart for $2795.

Contract for construction of Debrick bridge has been awarded to O. Soleim for $481.

Eureka, Cal.—Contract for construction of bridge across Cheney slough near Ferndale has been awarded to W. S. Selvage for $1114.80. F. E. Kelly bid $1120, J. H. Moore, $1443, and D. C. Farnell, $1450.

Fairfield, Cal.—A. H. Burton, Grass Valley, was the only bidder at $2666 for construction of two concrete culverts in Rio Vista township. Bid was rejected because too high, and work will probably be done by day-labor.

Contract for construction of the Sweeney Creek bridge has been awarded to Cerver Benson, Dixon, for $2155. Other bidders were: Fred Peacock, $2573, and A. H. Burton, $3955.

Healdsburg, Cal.—Contract for construction of bridge at North street has been awarded to Bailey-Comstock Co., 517 Fourth street, Santa Rosa, for $1552.50.

Marysville, Cal.—Contract for construction of bridge across Nigger Jack slough has been awarded to Jenkins & Wells, Sacramento, for $4788.

Modesto, Cal.—Contract for construction of reinforced concrete bridge on Oakdale-Waterford road has been awarded to C. E. Cotton, 16 California street, San Francisco, for $5330. R. W. Voorheis bid $5674.

Napa, Cal.—Contract for construction of stone bridge in Pope valley has been awarded to Harry Thorson, St. Helena, for $1640.

Contract for construction of wingwalls for another bridge in Pope valley has also been awarded to Harry Thorson.

Okanogan, Wash.—Bids will be received until October 9 by J. D. Hubbard, county clerk, for construction of three 90-ft. Howe truss spans over Okanogan river near Ellisford.

Oroville, Cal.—Contract for construction of bridge across Wyman's ravine has been awarded to Thomas Polk, Chico, for $2100. Chico Construction Co. bid $2150.

Contract for construction of bridge across Berry creek has been awarded to Chico Construction Co., Chico, for $1487.50. Thomas Polk bid $1494.

Red Bluff, Cal.—Bids will be received until October 9 by H. G. Kuhn, county clerk, for repairing a wooden bridge over Thomes creek.

Redding, Cal.—Contracts for construction of steel and timber bridge across McCloud river and for construction of reinforced concrete bridge across Churn creek have been awarded to F. H. Neilson at $7344 and $7744, respectively.

Ritzville, Wash.—Contract for construction of concrete bridge near Schrag has been awarded to C. G. Huber, Central Bdg., Seattle, for $6528.

Riverside, Cal.—Contract for construction of bridge at Murrietta has been awarded to Bibb & Neimann for $1998.

Sacramento, Cal.—Bids will be received until 2 p.m., October 15, by State Highway Commission for construction of three reinforced concrete bridges on state highway in Shasta county, one 30 ft., one 45 ft., and one 120 ft. long. Bids for this work were received once before but were rejected because too high.

Sacramento, Cal.—Contract for construction of bridge across Sacramento river at Rio Vista has been awarded to Tibbitts-Pacific Co., San Francisco, for $164,568. Expense will be shared by Sacramento and Solano counties.

San Diego, Cal.—Following bids were received for construction of reinforced concrete bridge across Los Flores creek on state highway: Fred Steffgen, $13,997; Holland Construction Co., $14,489; W. M. Ledbetter, $15,834; Davey & Hawkins, $15,999.

San Jose, Cal.—Following bids were received for construction of wooden bridge over Coyote creek on Metcalf road: J. H. Miller, $6067 (awarded contract); John Doyle, $6832. Engineer's estimate was $6520.

Contract for repairing bridge on Campbell avenue over Las Gatos creek has been awarded to John Doyle, San Jose, for $1787. Sam Sciarino bid $2100. Engineer's estimate was $1700.

Contract for construction of reinforced concrete bridge on Bodfish Mill road over Uvas creek has been awarded to William Radtke for $7390.

Santa Ana, Cal.—Contract for construction of bridge at La Habra has been awarded to C .McNeill, Santa Ana, for $1308.25. Other bidders were: J. S. Fluor, $1456.50; W. M. Ledbetter, $1485; and Wells & Bressler, $1862.

Santa Rosa, Cal.—Contract for construction of concrete bridge at Ducker ranch has been awarded to W. L. Proctor, 612 Sonoma avenue, Santa Rosa, at $1995.40 for the bridge and $0.825 per cu. yd. for extra grading.

Contract for construction of concrete culvert at Ort ranch has been awarded to Bailey-Comctock Co., Santa Rosa, at $735 for the bridge, $0.75 per cu. yd. for excavation, $0.35 per cu. yd. for embankment, and $1.65 per cu. yd. for gravel-ballast.

Ventura, Cal.—Bids will be received until October 16 by J. B. McCloskey, county clerk, for construction of two reinforced concrete culverts.

Contract for construction of wooden bridge over Conejo creek has been awarded to Mercereau Bridge & Construction Co., Pacific Electric Bdg., Los Angeles, for $1700.

A. A. Lemon, Santa Barbara, was the lowest bidder at $2089 for construction of concrete culvert on Los Angeles avenue.

Contract for construction of three reinforced concrete culverts and one corrugated-metal culvert on the Conejo road has been awarded to W. M. Ledbetter, Pacific Electric Bdg., Los Angeles, for $1774.81. J. P. Hunter bid $1788.20.

Yreka, Cal.—Contract for construction of 40-ft. reinforced concrete bridge over Moffitt creek has been awarded to Albert Anderson Co., Yreka, for $3800. John H. May bid $4473.

Contract for construction of 80-ft. reinforced concrete bridge over French creek has been awarded to John H. May, Dunsmuir, for $5740. Albert Anderson Co. bid $6975.

IRRIGATION AND WATER SUPPLY

Baker, Ore.—Contract for construction of concrete dam for Lower Powder Irrigation Co. has been awarded to Gilmore & Ritchie, Baker, for $5650. J. C. White bid $5685 and J. A. Hoskins, $7095.

Colusa, Cal.—Contract for construction of concrete intake on Sacramento river at Wilkins slough for reclamation district No. 108 has been awarded to Pacific Dredging Co., Flatiron Bdg., San Francisco, for $100,000. This intake will be used in connection with pumping-plant already constructed to irrigate about 60,000 acres of land.

El Paso, Tex.—Bids will be received until October 15 at office of U. S. Reclamation Service, for construction of lateral canals on Rio Grande project between El Paso and Ysleta, requiring 18,000 cu. yd. excavation. Plans are on file at office of 'Western Engineering.'

Merced, Cal.—Formation of irrigation district is proposed. E. G. Adams, Livingston; M. A. Marshall, Cottonwood; and A. H. Poor, Stevinson, are interested.

Modesto, Cal.—Following bids were received by Modesto irrigation district for enlargement of main canal between the Indian Hill fill and flume E, and between the Gasburg fill and the Morton fill: H. E. Macauley, Modesto (awarded contract), $26,875; Tieslau Bros., $31,200; Cahill-Vensano Co., $47,685.

C. E. Cotton, 16 California street, San Francisco, was low bidder at $30,230 for construction of three sections of concrete lining in the main canal between the Rairden fill and the Salter fill. Tieslau Bros. bid $30,492.50. Bids were rejected and work will be done by day-labor.

Following bids were received by directors of Modesto irrigation district for improvement of system:

Enlarging main canal between Mill Gulch and Indian Hill fills, Blake Bros. Co., $49,530 (awarded contract); Tibbitts-Pacific Co., $57,780; Cahill-Vensano Co., $61,957.50.

Reconstruction of concrete lining in main canal just below the Salter fill: Tieslau Bros. and Newsom & Henning, $16,085; C. E. Cotton, $16,150. Bids were rejected and work will be done by day-labor.

Enlarging main canal between Salter fill and entrance of Dallas-Warner reservoir: T. W. Sawyer (awarded contract), $29,450; Tieslau Bros. and Newsom & Henning, $45,600.

Construction of concrete lining in main canal below the Stone drop: M. Blumenkranz, $39,020; Tieslau Bros. and Newsom & Henning, $41,100. Bids were rejected and work will be done by day-labor.

Extension of Butler ditch: George H. Persinger, $4200 (awarded contract); J. D. Niman & Son, $5725; Tieslau Bros. and Newsom & Henning, $7510; M. Blumenkranz, $7680.

Oakdale, Cal.—Board of directors of Oakdale irrigation district is considering various plans for storage of flood-waters.

San Diego, Cal.—Following bids were received for construction of Lower Otay dam: Wurster Construction Co., Spreckels Bdg., San Diego, $420,134.75; H. G. Fenton, $450,000; James Kennedy, $586,736.75; R. P. Shields, $612,762; Twohy Bros. Co., $691,650. Shattuck-Edinger Co. bid cost plus 14%.

Wurster Construction Co., which was awarded contract for construction of Lower Otay dam for $420,000, has refused to sign the contract. Contract will probably be awarded to James Kennedy, Los Angeles.

San Francisco, Cal.—State Water Commission has received the following applications for permission to divert water:

A. H. Wohlfram, Colusa, 20 second feet from Sacramento river for irrigation. Plans include 75-hp. motor, 20-in. centrifugal pump, and main ditch four miles long. Estimated cost is $10,000.

Donald M. Thompson, Neenach, water for irrigation. Plans include earth dam with concrete core 50 ft. high.

F. H. Osgood, Seattle, 250 second-feet from branches of Illinois river for mining in Josephine county, Oregon. Plans include ditches and flumes costing $75,000.

J. B. Holly, Humboldt Bank Bdg., San Francisco, 15 second-feet from tributary of Truckee river for municipal supply of Reno. Plans include hydraulic-fill dam, 110 ft. high, and 14-mile pipe-line. Estimated cost is $250,000.

De Witt Van Ostrand, Phillips, Wisconsin, 40 second-feet from tributary of Illinois river for placer mining in Oregon. Plans include ditch 12 miles long. Estimated cost is $36,000.

Richard M. Dale, San Francisco, 750 second-feet from Middle Fork of Feather river for power. Plans include concrete dam 60 ft. high. Estimated cost of dam is $200,000, and the power-house $100,000 more.

J. Sank, Oroville, 28 second-feet from French creek for power. Plans include timber-crib dam 15 ft. high, and ditch, flume, and pipe-line 2½ miles long. Estimated cost is $136,000.

E. E. Lindsey, San Francisco, 30 second-feet from Bucks creek in Plumas county for power. Plans include timber-crib dam 20 ft. high and flume, ditch, and pipe-line 3¾ miles long. Estimated cost is $149,000.

Lora J. Moore, Tahoe City, ½ second-foot from creek in Placer county for power. Plans include rubble dam 16 ft. high and pipe-line 5800 ft. long. Estimated cost is $10,000.

F. C. Riley and G. W. Gilbreth, Los Angeles, 50 second-feet from streams in Los Angeles county for power. Plans include tunnel and pipe-line 6½ miles long. Estimated cost is $500,000.

John W. McKeehan, 2642 Benvenue avenue, Berkeley, 675,000 acre-feet of water from Calaveras river for irrigation. Plans include concrete diversion-dam and storage-dam. Total estimated cost is $2,500,000.

Waterford, Cal.—Bids will be received until October 20 by J. R. Browder, secretary Waterford irrigation district, for building structures on the irrigation system of the district requiring 135,000 ft. B.M. lumber, 230 cu. yd. concrete, 1040 sq. yd. cement-plaster lining, 610 lin. ft. of metal flume, and 3682 ft. of 12 to 36-in. concrete pipe.

LIGHT, HEAT, AND POWER

Mojave, Cal.—Election has been called for October 6 to vote on formation of lighting-district.

Sacramento, Cal.—Contract for construction of pumping-station for reclamation district No. 3 has been awarded to Latourette-Fical Co., Sacramento, for $19,350.

Salinas, Cal.—Contract for installing a Fess rotary boiler for heating courthouse has been awarded to Anderson & Dougherty for $490.

San Francisco, Cal.—State Railroad Commission has granted permission to Yosemite Power Co. to sell part of its property to Sierra & San Francisco Power Co., including water-right on Tuolumne river near Indian Bar, conduit 17 miles long, 900-kw. plant at La Grange, and transmission and distribution system serving part of Stanislaus county.

San Luis Obispo, Cal.—Bids for construction of lighting system and furnishing light were received from Santa Maria Gas & Power Co. and Midland Counties Public Service Corporation, but were rejected because they did not conform to specifications.

RIVER AND HARBOR WORK

Dayton, Ohio.—Bids will be received until November 15 by the Miami Conservancy district, for $10,000,000 worth of work in connection with the Miami Flood-Control project. The work is divided into 11 contracts, including several dams, channel-changes, and levees. The approximate quantities are as follows: excavation, 4,160,000 cu. yd.; embankment, 8,915,000 cu. yd.; concrete, 230,400 cu. yd.; paving and riprap, 10,500 cu. yd.; iron and steel, 1150 tons. Further particulars on file at office of 'Western Engineering.'

Manhattan Beach, Cal.—Bids will be received until October 17 by L. Price, city clerk, for construction of a reinforced concrete municipal pier on concrete piles. Pier will be 1250 ft. long and will require 2000 cu. yd. concrete.

Richmond, Cal.—City council has decided on the following apportionment of harbor expenditures: riprapping east side of the inner harbor bulkhead, $13,700; outer-harbor dredging, $44,400; west side of inner-harbor bulkhead, $18,772; riprapping, $24,800; rock seawall for outer harbor, $14,000; trestle and rails for spur-track, $20,700; purchase of right-of-way, $10,000; payment to Federal Government for dredging, $100,000. This will leave $139,000 in the harbor fund.

Following bids were received for work on clay bulkhead at inner har-

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bor: Healy-Tibbitts Construction Co. (awarded contract), $1860 for grading, and $34,820, $26,320, and $24,300, according to plans, for riprapping. Daniel Contracting Co., grading, $2000; riprapping, $40,000, $28,700, and $25,200. Blake Bros., grading, $2000; riprapping, $37,800, $27,300, and $26,100.

San Francisco, Cal.—Bids will be received until October 4 by State Board of Harbor Commissioners for construction of shed 30 by 110 ft. on pier 46.

Plans have been prepared and call for bids will be issued soon for reconstruction of pier No. 42, including driving piles, repairing deck, and construction of shed.

Seattle, Wash.—Contracts for construction of county dock on Duwamish waterway has been awarded to P. B. Church Co., White Bdg., Seattle, for $40,000.

RAILROAD WORK

Anaconda, Mont.—Contract for construction of 20 miles of railroad from Divide to mines of Elkhorn Mines Co. has been awarded to Clifton-Applegate & Toole, Anaconda.

Oroville, Cal.—Swayne Lumber Co. has awarded contract for construction of first seven-mile unit of extension of Butte & Plumas railroad from Berry Creek to Merrimac to A. Virgilio. Contract for construction of remainder of line will be awarded soon.

Western Pacific Railway will build spur-track, connecting its tracks with those of the Northern Electric Railway.

Pocatello, Ida.—Oregon Short Line has completed plans for about 40 miles of short feeder-lines in southern Idaho and northern Utah. Estimated cost is $1,000,000.

Portland, Ore.—Oregon-Washington Railway & Navigation Co. will construct railroad from Pine Creek, Idaho, southerly, nine miles. Estimated cost is $400,000.

Redlands, Cal.—Pacific Electric Railway will construct branch railroad in Yucaipa valley.

Seattle, Wash.—Contract for extension of municipal railroad has been awarded to R. H. Travers for $19,554.43.

Washington, D. C.—Government has received application to purchase 635,000,000 ft. B.M. of pine timber on the Sitgreaves National Forest and the White Mountain Indian Reservation, both in Arizona. If this timber is cut, it will be necessary to construct a railroad from some point near Holbrook, Arizona, southerly about 70 miles.

BUILDING CONSTRUCTION

Astoria, Ore.—William Wills, Crary Bdg., Seattle, was low bidder for construction of eight-story concrete warehouse for Port of Astoria.

Bakersfield, Cal.—Contract for construction of hollow-tile office-building for H. A. Jastro has been awarded to Currie & Dulgar, Bakersfield, for $83,450.

Bardsdale, Cal.—Contract for construction of hollow-tile school-building has been awarded to Hastings & Yeakle, Fillmore, for $14,197.

Bay Point, Cal.—Contract for construction of 50 dwelling-houses for employees of Pacific Electric Metals Co. has been awarded to F. R. Peake, Berkeley.

Belmont, Cal.—Contract for construction of school-building has been awarded to J. D. Henderson for $11,900.

Butte, Mont.—Contract for construction of Young Men's Christian Association building has been awarded to Nelson-Pederson Co., Butte, for $181,453.

Chico, Cal.—Hotel Oaks Co. has been formed to construct $150,000 hotel-building. W. J. O'Connor is president.

Ely, Nev.—Bids will be received until October 22 by F. D. Oldfield, county clerk, for construction of alterations and additions to county hospital.

Escondido, Cal.—Contract for construction of brick building for L. B. Thompson has been awarded to George Fickett, 935 West 35th place, Los Angeles, on a cost-plus-percentage basis. Estimated cost is $50,000.

Flagstaff, Ariz.—Contract for construction of reinforced concrete warehouse for Babbitt Bros. has been awarded to Edwards & Wildey Co., Black Bdg., Los Angeles, for $15,000.

Fresno, Cal.—Contract for making alterations in theatre-building for L. L. Cory has been awarded to E. Riggins, Tulare and H streets, Fresno, for $17,860.

Coates & Traver, Rowell Bdg., Fresno, have completed plans for brick building for Kirk school.

D. H. Trowbridge will construct $15,000 automobile salesroom.

Giant, Cal.—Bids will be received until October 22 by W. H. Williams, school clerk, for construction of school-building. Alternate bids will be received on a lump-sum and a cost-plus-percentage basis. Plans from clerk upon deposit of $10.

Gilroy, Cal.—Contract for construction of concrete and frame passenger-station has been awarded to Jones & McGovern, 2218 Los Angeles street, Berkeley, for $12,000.

Grass Valley, Cal.—W. Mooser, Nevada Bank Bdg., San Francisco, is preparing plans for class C building for town hall. Estimated cost is $20,000.

Great Falls, Mont.—Contract for construction of high-school building has been awarded to Rude & Searles, Great Falls, for $137,880.

Idaho Falls, Ida.—East Idaho Gas Co. will construct plant.

Long Beach, Cal.—Contract for construction of building for St. Luke's Episcopal Church has been awarded to C. T. McGrew, 1345 Ocean avenue, Long Beach, for $22,800.

Los Angeles, Cal.—L. A. Smith, Investment Bdg., Los Angeles, is preparing plans for reinforced concrete garage to be erected at 18th and Figueroa streets. Estimated cost is $50,000.

D. A. and M. A. Hamburger and W. H. Clune will construct class A hotel building at Broadway and Ninth streets. Estimated cost is $1,500,000.

Contract for construction of class C garage for Mrs. C. R. Price has been awarded to J. H. Bean & Son, Stimson Bdg., Los Angeles, for $10,000.

G. C. Harbolt, California Bdg., Los Angeles, will construct three-story class C building. Estimated cost is $90,000.

Manteca, Cal.—Contract for construction of reinforced concrete and brick building for Manteca State Bank has been awarded to D. W. Baysinger, Manteca, for $8997.

Modesto, Cal.—Contract for construction of brick and concrete building for G. F. Covell has been awarded to Carnell & Nelson, Turlock, for $20,000.

Contract for construction of high-school building has finally been signed by E. E. Etherton, Monadnock Bdg., San Francisco. The contract price is about $135,000.

Oakland, Cal.—Dickey & Donovan, 414 13th street, Oakland, are preparing plans for two branch library-buildings. Estimated cost is $35,000 each. Call for bids will be issued about November 15.

Orange, Cal.—Contract for construction of pre-cooling plant and packing-house for Santiago Orange Growers' Association has been awarded to Henry Clarke Co., 1101 East 5th street, Los Angeles, for $50,059.

Oroville, Cal.—State Supreme Court has rendered decision reversing the Appellate Court and sustaining the referendum regarding the proposed building for a hall of records. This will probably result in the entire matter being dropped.

Contract for construction of high-school building will be awarded to C. J. Guth, 28th and L streets, Sacramento. Guth's original bid was $63,965, anad this was later reduced to $63,500 by minor changes in the plans. Other bidders were: A. W. Littlefield, $66,631; Caldwell & Son, $66,898; C. G. Sellman Construction Co., $66,900; Robert Trost, $67,473; W. D. Henderson, $71,240; J. S. Hannah, $71,997; P. F. Riley, $72,906.

Pasadena, Cal.—Contract for construction of addition to Las Encinas Sanitarium has been awarded to Worschall Bros., 100 East Colorado street, Pasadena, for $18,000.

R. M. Hobbs, Boston Bdg., Pasadena, has completed plans for class A addition to Pasadena hospital.

Portland, Ore.—Contract for construction of brick garage for Freidman Bros. has been awarded to E. B. White, Lumber Exchange Bdg., Portland, for $25,000.

Contract for construction of alterations in Failing building has been awarded to Hurley-Mason Co., Worcester Bdg., Portland, for $200,000.

Contract for construction of Crane school-building has been awarded to Lindstrom Bros. for $12,500.

Sacramento, Cal.—Bids will be received until October 8 by W. F. McClure, State engineer, for construction of buildings for State Mining Bureau at Coalinga.

Bids will also be received until October 9 for construction of buildings for State Mining Bureau at Taft. Plans for both these structures from State Department of Engineering upon deposit of $15.

W. J. Miller, 417 Market street, San Francisco, is preparing plans for two-story brick and concrete packing-house for Libby, McNeil & Libby. Estimated cost is $140,000.

Following bids were received for construction of men's ward at county hospital: W. C. Keating, $45,700; Knowles & Mathewson, $46,595; W. Murcell, $49,984; Mathewson Construction Co., $51,629. All bids were rejected because too high and work will be postponed indefinitely.

Contract for construction of brick warehouse for Sidney M. Phillips has been awarded to W. Murcell, Ochsner Bdg., Sacramento, for $17,100.

San Diego, Cal.—Twenty buildings will be constructed for marine post. Estimated cost is $600,000. Lieutenant Ernest Swanson is commander.

San Francisco, Cal.—Contract for brick and terra cotta work on northeast wing of San Francisco hospital has been awarded to Emil Hogberg, 249 Edgewood avenue, San Francisco, for $4960.

Contract for construction of frame building for G. Molinari has been awarded to W. Little, 664 10th avenue, San Francisco, for $10,200.

Contract for construction of class C building for T. A. Driscoll has been awarded to J. H. Hjul for $16,280.

Albert Schroepfer, Nevada Bank Bdg., San Francisco, is preparing plans for brick apartment-house for L. D. Stoff. Estimated cost is $60,000.

W. H. Weeks, 75 Post street, San Francisco, is preparing plans for construction of reinforced concrete theatre-building for J. R. Saul. Estimated cost is $85,000.

Contract for construction of brick automobile shop for Walter Sullivan has been awarded to MacDonald & Kahn, Rialto Bdg., San Francisco.

Bids are being received by Harry Skidmore, Call Bdg., San Francisco, for construction of brick apartment-house for L. B. Hamm. Estimated cost is $40,000.

Contract for construction of brick building for Calhoun Bryant has been awarded to William Martin, 110 Jessie street, San Francisco, for $50,000.

W. H. Crim, Jr., 45 Kearny street, San Francisco, has completed plans for reinforced concrete warehouse to be erected on Market street near Ninth. Estimated cost is $35,000.

Rousseau & Rousseau, 110 Sutter street, San Francisco, have completed plans for three brick buildings to be erected at Van Ness avenue and Washington street. Contract for excavation for these buildings has been awarded to Eureka Teaming Co., 1818 Green street, San Francisco.

Rousseau & Rousseau are also preparing plans for brick building to be erected on Golden Gate avenue between Gough and Octavia streets. Estimated cost is $55,000.

William Wilde, 46 Kearny street, San Francisco, is preparing plans for class A building to be erected by Bank of Canton. Estimated cost is $75,000.

Contract for construction of mill-construction warehouse for Warehouse Investment Co. has been awarded to Lindgren & Co., Monadnock Bdg., San Francisco, for $175,000.

Contract for alteration of class C building at Battery and Pine streets has been awarded to G. P. W. Jensen, 320 Market street, San Francisco, for $38,500.

Cunningham & Politeo, First National Bank Bdg., San Francisco, have completed plans for alterations to Sutter Hotel.

San Jose, Cal.—Following bids were received for construction of frame-and-plaster isolation-hospital at infirmary: E. A. Bevans, $7936; P. E. Petersen, $7978; C. A. Thomas, $7998; R. S. McMillen, $8028; Al Compton, $8078; J. H. Miller, $8260; W. R. Latta, $8300; P. T. Jorgensen, $8328; John F. Dowle, $8500; W. A. McDaniel, $8523; James A. Lemieux, $8835; A. L. Adams, $8893; R. O. Summers, $9275. All bids were rejected because too high.

Following bids were received for construction of two-story frame building at county hospital: R. S. McMillen, $12,352; P. T. Jorgensen, $12,387; C. A. Thomas, $12,558; P. E. Petersen, $12,739; E. A. Bevans, $13,343; J. H. Miller, $13,450; A. L. Adams, $13,497; J. A. Memieux, $13,600; R. O. Summers, $14,468. All bids were rejected because too high.

San Pedro, Cal.—Contract for construction of packing-plant and dwelling-houses for San Pedro Packing Co. has been awarded to F. W. Colegrove, 577 Seventh street, San Pedro, for $30,000.

Contract for construction of brick building for W. Gardiner has been awarded to W. D. Lambert, 453 21st street, San Pedro, for $12,000.

Santa Barbara, Cal.—Myron Hunt, Hibernian Bdg., Los Angeles, is preparing plans for $1,000,000 hotel to be erected on Hope ranch, near city.

Improvements costing $1,000,000 will be made at Potter Hotel.

Seattle, Wash.—Contract for construction of brick-and-concrete garage for F. H. Bradshaw has been awarded to Warrack Construction Co., Arcade Bdg., Seattle, for $20,000.

John Graham is preparing plans for construction of building for Boston Drug Co. Estimated cost is $90,000.

Spokane, Wash.—Sperry Flour Co. will construct concrete grain-elevator.

Taft, Cal.—Bakersfield Garage & Auto Supply Co. will construct $20,000 building.

Tracy, Cal.—Bids are being received for construction of class C building for C. A. Black. Estimated cost is $35,000. W. H. Weeks, 75 Post street, San Francisco, is architect.

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